Planning and Evaluating
Collaborative Research and Extension

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December 2001 revision of
paper previously presented at:

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Abstract

This paper aims at forming a *common* understanding of collaboration by public sector research and extension (the latter may be called outreach) through presenting *two integrative theoretical models.* Sequential use of the two models should help research and extension staffs, agency administrators, and policy makers to communicate about as well as plan and evaluate joint extension and research efforts. The models suggest ways to define the scope of a collaborative research and extension project, set its priorities, plan its conduct, evaluate its effectiveness, and utilize the evaluation.

A *macro-stage model combines* existing, *disparate* models of roles and linkages among research, extension, and users. The model identifies *generic roles* of researchers and of extensionists in generating and diffusing strengthened capacities and innovations relative to needs and resources of users and the general public.

A *micro-step model* suggests an approach to *planning and evaluating each of the generic roles* of researchers and of extensionists that are identified by the macro-stage model. The model promotes research and extension collaboration by identifying a *parallelism* between comparable research objectives and extension objectives.

Tandem use of the macro-stage model and the micro-step model can help to develop *at the outset* of a collaborative project the *output* and *impact* objectives for its extension function as well as for its research function.

The paper advocates *systemizing* results of collaborative *project*s in order to utilize them in extension *programs*. Higher education may collaborate with research and extension. In projects where these three functions focus on rapidly achieving widespread public benefits, higher education roles are viewed primarily as supportive of research and extension roles.

Methods are suggested for establishing research and extension *partnerships*, as well as obtaining stakeholder involvement. Resources needed to plan a collaborative project are seen to *exceed* those needed to plan a research project or an extension project of comparable size.

Acknowledgments

Our respective agencies--as well as federal, state, and university colleagues--have supported preparation of this paper. In addition to those individuals named below, numerous other reviewers provided substantive comments and suggestions.

The authors are solely responsible for the contents of this paper, which do not necessarily reflect the official views or policies of our respective agencies.

The individuals named below have provided helpful comments on portions of the paper or review comments on the entire paper. Mention of their names does not necessarily imply their endorsement of the paper's contents.

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Assistance in producing this paper was provided by several staff of Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture:

- Annetta Barnes-Oates, LaTracey Arrington, and Wendy Light Reid helped to produce the graphics; and
- LaTracey Arrington, William Scott, and Joan White provided consultation on word processing.

Joan White, Joe Fulks, and Annetta Barnes-Oates wove the web site introduction to this paper.

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Executive Summary

Stronger linkages between public sector research and extension are needed to accelerate the development and adoption of cost-effective, knowledge, technologies, and practices. Research and extension (the latter may be called outreach) can *increase their separate and collective rates of return* through strengthening linkages with each other.

In the United States, recent legislation and budgetary initiatives have stimulated increased collaboration between research and extension in agricultural and agriculturally-related programs. In Australia, linkages between agricultural research and extension also are being strengthened--principally by pressures for privatization and greater accountability.

Little theoretical guidance is available for planning and evaluating collaborative (i.e., integrative) research and extension projects. This paper presents *an integrative approach* in providing such guidance.

The integrative approach suggests ways to define the scope of a collaborative research and extension project, set its priorities, plan its conduct, evaluate its effectiveness, and utilize the evaluation. Use of the approach should heighten effectiveness and efficiency of the development, implementation, and evaluation of collaborative projects.

The paper aims at forming *common* understanding, expectation, and language about collaboration by public sector research and extension. *Integrative approaches or models--held in common* by staffs, administrators and policy makers who perform research and extension functions--should help these parties to better communicate about, plan and evaluate collaborative projects. The thesis advanced is that cost-effective *collaboration requires the use of integrative models*.

The paper presents *a macro-stage model* and a *micro-step model* to support collaborative programs and projects intended to generate and diffuse strengthened *capacities* and *innovations*. The macro-stage and micro-step models should help agencies, programs and projects *plan for, monitor, and evaluate* the generation, diffusion, and utilization of capacities and innovations within numerous sectors of society. The paper applies these two models to collaborative *research* and *extension* projects within the agricultural and agriculturally-related sector.

Tandem use of these two models should help project staffs and stakeholders to build stronger linkages within projects that aim to bridge across research and extension efforts.

Within their respective communities and in external representations of their work, researchers and extensionists tend to embrace *disparate* models of their respective roles and relationships. The differences between their views, reflected by these disparate models, *inhibit* collaboration.

Thus, first presented is the macro-stage (interdependence model) which *combines* the disparate models of research and of extension and their inter-relations. The macro-stage model identifies *generic roles* within the *overall* process of development, diffusion, and utilization of *capacities* (e.g.,

knowledge) and *innovations* (e.g., technologies and practices).

Four macro-stages and generic roles within each stage are identified by the model. Stage I "establishes efficacy;" Stage II "tests and refines;" Stage III "promotes and responds;" and Stage IV "utilizes." The generic roles of stage I are--"discover," "invent," and "develop;" those of stage II are--"assess," "commercialize," "adapt," and "systemize;" stage III roles are--"transfer," "educate," and "retrieve;" and stage IV roles are--"appraise," "use," and "evaluate."

Stage II often is a *weak link* in the overall process of generation, diffusion and utilization, because this stage generally is in neither the "main stream" of research nor of extension. Thus, there often is a need to *emphasize Stage II* in collaborative projects.

The *micro-step model* is next presented; it suggests a *hierarchal approach* to planning and evaluating *each* of the *generic roles* of the research and the extension functions that are identified by the macro-stage model.

The micro-step model's "logical chain of events" characterizes the general features of most projects that generate and/or transmit practical information. The means-ends chain suggests a hierarchy of objectives and evaluation criteria for each of the roles of research and of extension identified by the macro-stage model. Thus, the hierarchal model supports *efficient* planning and evaluation of *outputs* and *impacts* of extension as well as of research.

Each successively higher level in the hierarchy potentially can provide stronger evidence of project accomplishments relative to identified, desired societal or community conditions. However, the difficulty and cost of obtaining evidence of such accomplishments generally increases as the hierarchy is ascended.

The micro-step model promotes collaborative research and extension by identifying a *parallelism* between comparable research objectives and extension objectives. This parallelism can help to *integrate* administration, planning, evaluation, and reporting of collaborative projects.

Use of the macro-stage model followed by use of the micro-step model can help to: (a) develop*, at its outset,* a collaborative project's extension objectives as well as its research objectives; and (b) and systematically *link research objectives and extension objectives*.

The paper cites the necessity of extension staffs' *systemization* of results of collaborative projects in order to utilize them in broader extension *programs.*

Higher education may collaborate with research and extension in integrative projects. In projects where these three functions focus on rapidly achieving widespread public benefits, higher education roles are viewed primarily as supportive of research and extension roles.

The paper suggests methods by which to establish research and extension partnerships as well as obtain stakeholder involvement. Due to added complexity, *resources* needed to plan and evaluate a collaborative project are seen to *exceed* those needed for a research project *or* an extension project of comparable size.

Planning and Evaluating Collaborative Research and Extension

A common future is shared by public-sector agencies that conduct research and those that extend knowledge, technologies and practices to users. Feller et al. (1984, 23-24) maintain that unless strong linkages are maintained between public-sector research and extension (i.e., outreach), each will receive less than optimum support from society, and important societal goals will fall short of attainment.

Stronger linkages between research and extension are needed to accelerate the development and adoption of cost-effective, appropriate knowledge, technologies and practices. Stronger linkages benefit both the general public and users of knowledge, technologies and practices, by increasing effectiveness and efficiency in solving complex problems. The need to strengthen linkages between publicly funded research and extension is acknowledged world-wide in the agricultural and agriculturally-related sector (e.g., Kaimowitz 1990; McDermott 1987; Rogers et al. 1988, 15-16; Röling 1990; van den Ban and Hawkins 1996).

This paper's thesis is that *use of integrative theoretical models is essential to achieving stronger linkages* between research and extension. Two inter-related theoretical models are advanced in order to promote strengthened linkages between these two functions. Examples are provided to portray model use in planning and evaluating programs and projects that address agricultural production, natural resource conservation, and environmental protection. The models also should directly apply to other domains in which research, and the extension of research findings and products, are combined to solve practical problems of users and of society.

An aim of this paper is *common* understanding, expectation, and language about collaboration between research and extension. Such sharing should serve to further articulate research and extension programs and projects[1] seeking attainment of common goals.

Emphasis is placed on developing *at the outset* of a collaborative project its extension objectives as well as its research objectives (Jiggins 1993). Thus, the paper steers collaborative projects away from "triggering" the substantive planning for their extension function *only after* the project's research results become available.

Research activities and extension activities are viewed as semi-autonomous and mutually supportive elements of the overall advance of knowledge, technology, and their uses. This paper assumes that research and extension: (a) generally are *interdependent*, and partly overlap and blend into one another at their margins; and (b) are two different *functions and therefore cannot* be totally integral or fused. However, in genuinely collaborative research and extension projects, there *is total integration* of overall administration, funding, planning, evaluation and reporting.

In projects where higher education collaborates with research and extension--and all three functions focus on rapidly achieving widespread public benefits--higher

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[1] As defined herein, *projects* are developed and conducted within *programs*. Projects address specific problems and objectives relative to broadly-stated program goals. Use of the term project may imply its connection with a program.

education roles are viewed as primarily supportive of research and extension roles.

The paper's usefulness will be evidenced by how well it helps to strengthen and articulate linkages within and promotes effectiveness and efficiency in planning, implementing, and evaluating collaborative projects.

Coordination to Collaboration

Three types of linkages among related structures have been identified (Taylor-Powell et al. 1998). *Coordination* minimally links structures that have *convergent* aims and activities. When coordinating, research and extension each focus on the same goal but retain separate programming processes, authorities, and resources.

Cooperation entails *joint effort*s to achieve common goals. Here, extensionists and researchers[2] *jointly* plan as well as share and/ or transfer resources, but they operate under their respective authorities.

Collaboration searches for and implements joint solutions that *transcend* separate structures and their respective functions; separate authorities and resources are *merged, i.e., integrated* and vested in a newly-formed, collaborative program or project. In collaborative research and extension projects, *there is integration* of administration, funding, planning, evaluation and reporting.

Trends in Australia and the U.S. show a tendency to *build collaboration upon pre-existing coordination* and *cooperation* between publicly funded research and extension.

Trends in the United States

In the U.S., agricultural research and extension historically have coordinated and cooperated to develop--and gain broad understanding and adoption of--research-based knowledge, technologies and management practices (e.g., Rogers et al. 1978). Beginning about two decades ago, the U.S. Congress and national policy makers increasingly fostered *cooperation between* state Experiment Stations and state Extension Services[3] through enacting legislation and appropriating "ear-marked" funding (Food and Agriculture Acts 1977 and 1981; Food Security Act 1985; Office of Technology Assessment 1990). For example, between 1985 and 1990, the Congress initiated *parallel* appropriations

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[2] "Extensionists" herein are defined as those whose assignment, or primary assignment, is to conduct extension activities; "researchers"are defined as those whose assignment, or primary assignment, is to conduct research activities. These definitions cover most staff whose assignments include performing both research activities and extension activities.

[3] Experiment Stations and Extension Services are units of U. S. land-grant universities, and through legislation are partners with the U.S. Department of Agriculture (Extension Services also partner with county governments). Collectively, these units of land-grant universities conduct research, technology/practice development, and information transfer and non-formal (not-for-academic credit) education. Aims include: improvement of agriculture including provision of food, fiber, and other agriculturally-based products; conservation of natural resources; and development of youth, families, and communities.

for state Extension Services and state Experiment Stations to conduct mutually supportive (i.e., cooperative) programs of food safety and water quality.

Relatedly, a Joint Ad Hoc Committee of the National Association of State Universities and Land-Grant Colleges (NASULGC) recommended enhanced cooperation between state Experiment Stations and state Extension Services (ECOP, ESCOP, and CAHA 1988). Clarifying the role of *extension staffs in conducting adaptive research* and the role of *research staffs in conducting direct technology transfer to end-users*, the Ad Hoc Committee recommended joint program planning and priority setting mechanisms at both the state and federal levels.

In 1988, the Congress authorized and began to fund the U.S. Department of Agriculture to launch a program of low-input, sustainable agriculture (Cooperative State Research Service and Extension Service, 1988). This national program, now called Sustainable Agricultural Research and Extension, supports collaborative project teams that include *both researchers and extensionists* as well as other public sector and private sector cooperators (Auburn 2001).

In 1994, the Congress merged the U.S. Department of Agriculture's former Cooperative State Research Service and its former Extension Service into the Cooperative State Research, Education, and Extension Service (CSREES). This merger has facilitated cooperation and collaboration among university extension, research, and teaching efforts nationally.

The 1996-legislated Fund for Rural America, and the Agricultural Research, Extension, and Education Reform Act (AREERA 1998), authorize programs and projects that *integrate, i.e., link* extension, research, and higher education.[4] CSREES programs authorized under AREERA include support of collaborative projects across the functions of research, extension, and college teaching. Projects are awarded competitively, and federal funding is transmitted to "integrated accounts" at recipient colleges and universities.

Even before the above legislation of the 1980's and 1990's, state Extension Services, state Experiment Stations and Colleges of Resident Instruction already routinely co-mingled significant portions of their extension, research, and/or teaching funds and staff resources via joint faculty appointments as well as task forces. Moreover, research-extension collaborative projects may be initiated by non-CSREES funding, including projects funded by other federal agencies and non-federal sources, e.g., commodity groups, watershed associations, and state agencies.

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[4] AREERA authorizes Initiative for Future Agriculture and Food Systems, which receives congressional funding to support projects that integrate university research, extension, and teaching. AREERA (Section 406) also authorizes projects that integrate university research, extension, and teaching for projects to improve food safety, water quality, pest management, and transitioning to organic farming.

AREERA also mandates *joint* planning for the expenditure of up to one-quarter of the annual federal *formula funds* provided to state Experiment Stations and state Extension Services.

Trends in Australia

Moves toward research-extension programming also are evidenced in Australia. Such movements have occurred within several state governments (e.g., Agricultural Industries Team 1997; McDonald and Kefford 1999); within the public-sector/private sector national rural research and development corporations; and within federal research agencies. The trend toward cooperative and collaborative research and extension programming in Australia is partly a result of *legislatively commissioned reviews.* These have led to legal and administrative restructuring of state and federal research and extension providers (e.g., Bureau of Industrial Economics 1993; Industry Commission 1995; Kerin 1992; Watson et al. 1992; Watson 1996).

The focus of legislatively commissioned reviews and consequent restructuring has tended to fall into one or the other of two categories. The first concerns the level of support given agricultural research and extension as the size of agriculture declines relative to other segments of the Australian economy. As there are relative declines in budgets for agricultural research and extension, there has been increasing *pressure to improve their singular and collective relevance, efficiency, and targeting* (Marsh and Pannell 1998).

Focus of the second category of legislative reviews concerns the increasing influence of economic theory within state and federal governments. The net result has been policy shifts toward principles of *accountability* and "*user pays*" (Vanclay and Lawrence 1995).

Australian state agencies with responsibility for agricultural research and extension traditionally have performed these functions separately. However, reduced state expenditures for research and extension, over the past fifteen years, have changed the *natures of* and the *connections between* these agencies.

All state departments responsible for agriculture and natural resource programs currently profess a "customer driven" focus;[5] and, increasingly, state research and extension projects are performed through a series of alliances that may extend to other public agencies as well as private-sector organizations.

Most state research and extension programs now receive considerable support from commodity or rural industry institutes, a step toward *privatization* that tends to reduce the separation of work by research staffs and extension staffs. University faculty and graduate students increasingly are collaborating with governmental research and extension personnel.

Formal reviews concerning federal research have focused on performance and accountability. Accountability of research agencies is especially important in Australia because of the public-sector's dominance in research investments (McFarlane 1999).

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5 A similar focus on customers and commercialization is evident in the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The CSIRO exercises national leadership in developmental research and its utilization for all sectors of Australia's government, economy, and society including agriculture and rural development.

Linkages between public-sector/private sector research and commercial technology development has been weak, thus inhibiting the commercialization of research results. A number of incentive programs recently have been developed to enhance the commercialization of public-sector research results.
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Public/private joint ventures in research and development have increased in the face of decreased protectionist policies and the deregulation of agricultural industries and commodity markets (McFarlane 1999). For example, the federally introduced Cooperative Research Centres (CRCs) foster collaborative research between government agencies, universities, and industry.

The CRCs require *clearly defined pathways* for commercial use of research findings and resultant technologies (Slayter 1992). This requirement has strengthened relationships between public-sector research and extension, fostered by the involvement of industries as business partners.

National public/private rural research and development corporations (established within the past two decades by the Australian federal government) generally require projects that they fund to conduct *collaborative* research, extension, and commercialization processes.

Alternative Models

Formal agreements to conduct collaborative projects may be effected by project proposal requirements to acquire project funding. However, creative, *full-fledged* collaboration between research and extension staffs must also be based upon a *shared vision* and *recognition of interdependence.* This can help transcend functional and structural differences as well as potential competition and conflicts, in order to foster strong linkages across staffs of research-extension projects.

The above motivations to engage in research-extension collaboration--i.e., a desire for resource acquisition, a shared vision, and mutual recognition of interdependence--may be *partly* harnessed through: (a) effective project *communications* and *participatory processes* (World Bank 1996); (b) *joint appointments*--i.e., staff positions that encompass both extension and research responsibilities; and (c) *mission-oriented*, *problem-solving teams* advised by stakeholders including end-users (Bennett 1990, 117-158).

But to *fully* harness motivations to collaborate also requires the use of *theoretical models* that adequately support collaborative projects. Cutting across the motivations, structures, and processes that drive and support collaborative projects, such models *catalyze* each of these "whys" and "hows" of collaboration.

Theoretical models are symbolic structures that represent patterns of interactions--in this case, among those who conduct research and, extension to meet identified needs of both the general public and users of research-based knowledge, practices and technologies. A theoretical model presents a plausible causal explanation--i.e., a theory--of some type of phenomena. In this case, the explanation is of how one or more agencies, programs, or projects work to solve identified soci-cultural, economic and/or environmental problems; such models are based on logic as well as empirical evidence, and generally posit one or more intermediate steps toward problem solution (Jordan 2000; Rogers 2000a).

Use of theoretical models can enhance the development, implementation, and evaluation of collaborative projects. They can do so by providing a sound basis for *common understandings of, and common expectations for,* strengthened linkages. Such models also can usefully serve as common starting points for discussing the roles of researchers, extensionists, and users in the pursuit of common aims.

No single, existing model of roles and linkages across public-sector research and extension enjoys general recognition and acceptance. To the contrary, *researchers and extensionists tend to embrace disparate types of models* of their respective relationships with each other and stakeholders including clientele. Such disparate models often contribute to chasms between the research function and the extension function.[6]

In particular, there is *lack of a common* understanding and expectation regarding how roles performed by extensionists relate--or may most effectively relate--to those performed by researchers. This lack of common understanding stems partly from the *disparate and restricted* views of extension presented by the two presently leading categories of models that characterize linkages between research and extension. These two categories may be called *research-transfer models* and *learning-system models*.

Research-Transfer Models

Researchers generally use *research-transfer models* to characterize their own roles, and the roles of extensionists and end-users of research-based practices and technologies (e.g., Bonnen 1986; Feller et al. 1984; McDermott 1987; Office of Technology Assessment 1986).

Research-transfer models *first* pay attention to research activities and the development of technologies and practices; *subsequently* they consider roles of extension in diffusing the technologies and practices to users. Holt's research-transfer model (1986), which emphasizes public-sector rather than private sector research, is adapted slightly and presented in Figure 1.

See Figure 1 [attached]

Consistent with suggestions made both by European and American experts (e.g., Engle 1987; Meyers 1985), Holt's model acknowledges:

- o *two-way communication* between staffs having responsibility for research and those having extension responsibility, as well as
- o *role sharing* or *overlapping functions* (e.g., nearly all state agricultural extension specialists in U.S. state Extension Services--and also many multi-county area extension agents as well as

[6] Studies of ways to improve linkages between researchers and extensionists frequently have examined differentials in staff perceptions, attitudes, communication patterns, and institutional positions (e.g., Lupanga 1995; Feller et al. 1984; Rogers et al. 1988). However, there has been little examination of differing models' effects on interactions between extensionists and researchers.

county extension agents--conduct some type of applied research).[7]

Learning-System Models

Extensionists generally use *learning-system models* to characterize their own roles and the roles of researchers and end-users of research-based practices and technologies (e.g., Boomsma et al. 1996; Boone 1985; Dalgaard et al. 1988; McKenna 1987).

Learning-system models *first* pay attention to planning extension efforts: these models cite research findings--and research-based technologies and practices--as *one* of several types of *contributors* to the selection of extension objectives, subject-matter content, and recommendations for clientele. Several of the many other factors that influence the development of extension efforts within a learning-system are depicted in Figure 2 (Ad Hoc Committee on Program Development 1974; Black 2000, 494-496).

See Figure 2 [attached]

In *addition* to research and development contributions, factors in planning extension efforts include: any *current* departures from the problematic conditions that gave rise to the research and development findings and products; *current* self-expressed needs of clientele; and *current* interest-group pressures. Also cited as a factor is participatory clarification of all technical options--including those that are indigenously-based--relative to minimizing uncertainty about their respective consequences.

Thus, extension program development deals with *several factors* beyond the factor of available research findings. Occasionally, these factors take temporary *precedence* over extension aims to transfer to audiences specific sets of research findings and recommendations.

Learning-system models,[8] address two extension roles. These are *"information transfer,"* (i.e., agency staff promotion of and user adoption of *particular* practices and technologies) and *"nonformal education"* (i.e., enabling enlightened decision making through leaning effective processes as well as accepted principles).

In implementing both information transfer and nonformal education, extension staffs may employ group and individual "facilitation"– i.e., promote mutual understanding and direct information exchange between researchers and users (Coutts 1997)--or, alternatively, extension staffs themselves transfer research-based knowledge *directly* to users. Other processes identified in learning-systems are (a) linking to partners in other action agencies (Rockwell and Bennett 2000), and (b) obtaining feedback regarding program effectiveness (Marshall 1990) of influencing clientele learning, practical applications of learning, and problem solution.

[7] Federal legislation enables state Extension Services to expend USDA funding received to "...develop practical applications of research knowledge@ (Food Security Act 1985, Section 1435a).

[8] These models represent learning by out-of-school audiences, including "nonformal" learning; i.e., not-for-academic credit. Such learning often is associated with "adult education."

Disparities and Limitations

Three disparities between research-transfer models and learning-system models are evident. First, research-transfer models ignore the *multiple* factors which contribute to plans for extension efforts. Research-transfer models portray research and development results (e.g., knowledge, technologies and practices) as the *singular basis* for planning extension efforts. Learning-system models, on the other hand, identify research and development results as *one of several* bases for planning extension efforts.

Misunderstandings of how extension programs are developed likely occur when they are viewed *only* within the context of research-transfer models. Such misunderstandings are illustrated by the following quotation (Office of Technology Assessment 1985, 73):

> . . . it must be remembered that the root of extension is research . . . extension is, therefore, delimited by the scientific endeavors of the research components of the agricultural research system, including both the public and private components.

Contrary to the quotation above, learning-system models recognize that *extension efforts have multiple "roots,"* with each root having importance during program development, delivery, and evaluation.

Research-transfer models, by themselves, are *incapable* of providing rationale for extension efforts that differ in scope and content from research and development results. This is because research-transfer models fail to acknowledge that, for extension to succeed, it must tap and engage sources of influence that are far broader than its research base.

An example includes efforts both in Australia and the USA to help agricultural producers remain economically viable during farm financial crises. Under such conditions, extension tends to emphasize the provision of *education* to build producers' personal abilities and skills (including those of risk management) in order to foster self-reliance as economic conditions change.[9]

Identifying the above role flags a second disparity between the two types of models: research-transfer models omit extension's *educational role*. This role *transcends* extension's information transfer role which promotes adoption of specific practices and technologies (Boyle 1981, 18-29; Coffey 1996; Office of Technology Assessment 1988, 34; and Röling and Jiggins 1994).

Information transfer focuses on informing audiences about, and promoting use of, specific applicable knowledge, technologies and practices. Education is a more generalized type of learning. It enables both individuals and groups to cope with existing and *changing conditions* by increasing their abilities to solve problems through increased comprehension and application of:

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[9] During periods in which producers experience high debt and low return, extension often downplays the promotion of costly technological products. Priority during such periods has been to help producers understand and adopt alternate practices to cut costs, develop marketing strategies, and seek refinancing options (e.g., Klair 1991).

- o scientific or other accepted principles regarding the governance of biological, psychological, economic, social, and environmental conditions and events, as well as;

- o individual and group problem-solving and decision-making processes.[10]

A third disparity is that learning-system models ignore extension's (a) engagement in *applied research*, and (b) influence on priorities for research by public and private sector research agencies. Learning-system models generally provide *little multi-functional context* for understanding relationships between roles of those who conduct extension and those who conduct research.

Learning-system models omit the fact that public-sector agricultural extension and research usually share common institutional bases and have multi-faceted linkages and overlapping organizational and programmatic responsibilities. This omission is tempered by acknowledgment that objectives and methodologies of extension programs generally are open for negotiation with program participants, and thus are *"co-owned"* by participants (Wolek 1989).[11]

A *major limitation both of research-transfer models and learning-system models* is their inference that substantive planning for the extension function of a collaborative project begins *only after* research results become available. That is, where either research-transfer or learning-system models predominate, there is only anticipation of *sequential research and extension* planning based on a diffusion perspective (Rogers 1995): both types of models tend to lead to the expectation that extension *select its objectives in response* to the "trigger" of availability of research and development results.

Thus, a project planned on the basis of a research-transfer model would not likely include substantive extension objectives *set at the outset* of the project. If general, yet

[10] Education helps program participants make Aenlightened decisions," through enabling them to learn and apply fundamental principles and problem-solving processes. The latter include: gaining access to and evaluating information, identifying goals, comparing alternative actions to achieve these goals, evaluating tradeoffs among alternatives actions, and applying lessons learned from observing results of past actions (Bennett 1990, 55-59, 106-115; Röling 1986; Woods 1987).

[11] Such co-ownership may be a potential concern for administrators charged with achieving extension agency objectives. A full discussion of how assertive participation by users might be achieved--without compromising the achievement of outcomes that are legislatively and administratively mandated--lies beyond the scope of this paper. Such achievement, however, *does* require a fully developed understanding of participative processes.

There is evidence that the process of developing "co-ownership" generally enhances the capacity of extension to deliver required outcomes. Pretty (1995) provides an overview of types of participation that may be employed. Extension often expends significant financial resources to lift farmers' and allied groups' skills in group-based, participatory activities (Marsh and Pannell 1998).

substantive, objectives are not established at a project's outset, there is no way for extension staff of the project to *prepare for* rapid, effective and efficient transfer of the emergent knowledge, technologies and/or practices to potential users. By contrast, the use of an interdependence model leads a collaborative project to *simultaneously* set both its extension objectives and its research objectives at its *outset*.

Interdependence Models

Because of the disparities between research-transfer models and learning-system models, staff of collaborative projects may face a dilemma in selecting a model that is mutually acceptable to contributing researchers and extensionists. This dilemma may be resolved by *combining attributes* of research-transfer models and learning-system models. Interdependence models, in effect, *combine* these differing perspectives.

Interdependence models consider *concurrently* the functions of extension, research, and users--and the continuous, mutual dependencies among them--in both the improvement of knowledge, practices and technologies and the widening of their usages (e.g., Bennett 1990, 1994; Lipman-Blumen and Schram 1984). The extension function and the research function, over the duration of the time period for programming, are *simultaneously* considered.

Interdependence models respond to insistence by Engle (1987) and Meyers (1985) that models of research-extension linkages show *parallel*, as well as sequential, relationships between research functions and extension functions (e.g., there exists *comparable* networking both by researchers and extensionists to assess current and emergent needs for performance of their respective roles). Thus, interdependence models help to correct a *common limitation* of both research-transfer models and learning-system models: i.e., an assertion that planning for a project's extension function only follows availability of the project's research findings.

An example of an interdependence model is that offered by *farming systems research and development.* Farming systems research and development involves extensionists from the outset of project planning, and gradually increases the magnitude of their overall role as a project evolves toward site-specific testing and diffusion of research findings and/or products (Beal 1982; Petheram and Clark 1998). Farming systems research and development represents "co-learning," by project staffs and farmers, with intent to develop both agricultural knowledge systems *and* farming systems through high levels of project participation by end-users including enterprise managers.

In representing collaborative research and extension projects, interdependence models generally portray a more balanced, comprehensive, and accurate view of generic extension-research roles and relationships than do either research-transfer or learning-system models. Thus, interdependence models may contribute to *resolving conflicting expectations* about processes, roles and relationships of extension and of research; these models articulate an *overarching and balanced view* of extension, research, and stakeholder relationships.

Such an overarching view is asserted to be: (a) *important* for furthering coordination and cooperation between extension and research; and (b) *essential for collaborative projects*--e.g., CSREES-supported integrative projects, as well as state agency assigned projects that include members of research staffs and extension staffs.

Research-transfer and learning-system models identify some of the *same* roles for extension, but each also identifies roles for extension *not identified* by the other. Attributes of extension characterized by the three categories of models--i.e., (a) research-transfer models, (b) learning-system models and (c) interdependence models--are summarized in Table 1. Interdependence models provide better support for

Table 1 [attached]

collaboration than do the other two types of models, because interdependence models include *all* the characteristics of extension identified by research-transfer models and learning-system models (Bennett 1993).

According to interdependence models, the processes and functions of *public-sector extension* are as follows (see Table 1). Extension staffs of public-sector agencies:

- o *Plan their efforts based on a wide variety of assessments, influences, and information*. These include the following, in addition to information from public-sector (as well as industrial) research and development: influence by advisory councils; market research on current needs of different types of consumers and technology and practice users; census and related data; utilization of program evaluations; and *technical "non-research" based information* including: implications of regulations, statutory-based economic incentives, commodity marketing signals, credit opportunities, public policy issues, weather-related factors, and experientially-verified "indigenous knowledge."[12] (Research-transfer models imply that extension programming is based simply on results of research and development activities).

- o *Conduct applied research*, as necessary and feasible, whenever available knowledge and practices are not sufficiently user-oriented or adapted to site-specific conditions.[13] (Learning-system models omit the fact that extension staffs often conduct applied

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[12] Also, a great variety of *social and cultural norms* affect clientele decision-making processes within the context of technical information transfer and educational roles performed by extension agents (van den Ban 1997 and 1998).

[13] Gaps often exist between research results of state Experiment Stations and the *site-specific* adaptations required to maximize usefulness of these outputs to end-users. Such gaps may occur partly because conducting adaptive research often is not professionally rewarding to university researchers: findings from such applied research lack universality, and therefore also often lack potential for professional disciplinary or interdisciplinary refereed publications (Feller et al. 1984, 124, 233-234). Thus, the generic technologies and practices produced by Experiment Stations often require site-specific adaptation before they can be included in extension programs (Feller et al. 1984, 124, 233-234). Therefore, it frequently is necessary for extension staffs to conduct the site-specific, adaptive research necessary for the content of their programs to be credible to local clientele (Nowak et al. 1997, 29-30).

research to test, adapt, and systemize practices and technologies--prior to conducting information transfer).

- *Influence research priorities* by informing researchers about: (a) socio-cultural, economic, psychological, environmental, technological and other needs of a *spectrum* of users; (b) users' *evaluations* of current research outputs; and (c) users' *advice* regarding needs for further research on, and development of, technologies and practices. (Learning-system models overlook extension's influence on applied research activities).

- *Transfer both information and recommendations* regarding specific practices and technologies in order to guide users' consideration and adoption of them. Methods vary from "hi-tech"--e.g., a broad variety of computer-based techniques--to "high touch"--e.g., interpersonal visits with those in a position to influence adoption by users (Research-transfer models and learning-system models both recognize this role and its attributes).

- *Provide education* for technology and practice users, and for the general public, in order to enable them to make "enlightened decisions" by employing effective processes and principles of decision making. *Understanding, as well as applying, basic principles and processes* can help people assess payoffs and/or risks when deciding on whether not to adopt specific practices and technologies. Simply put, information transfer trains audiences "*what* to do," while education teaches them "*how* to think and apply principles." (Research-transfer models omit extension's role in *educating* users and the public).

In general, the priorities of *public-sector* extension in the U.S. and Australia (and other economically developed countries) appear to be shifting in two ways. First, the roles of extensionists in conducting *adaptive research* and *non-formal education* are increasingly important, relative to the role of transferring particular technologies and practices to end-users (Bennett 1990 and 1992; Röling and Jiggins 1994). Second, the role of transferring technologies proven to be significantly profitable is being shifted to *commercial* extensionists (Bennett 1996; Lawrence 1987; Vanclay and Lawrence 1995).

Macro-Stage Model

The macro-stage model presented below identifies *publicly funded research* and *extension* as two elements in an *overall complex* comprised of public-sector agencies, private-sector organizations, and individuals.[14] This complex generates, promotes, and uses strengthened *capacities* and *innovations* to help met priority needs of

[14] The macro-stage model acknowledges that public-sector research and extension are in a position to do *only part* of the total job of development and diffusion of capacities and innovations. For example, public-sector agricultural extension often works mainly--both in Australia and the USA--with specific segments of end-users; e.g., farmers who have moderately high achievement tendencies. Other types of end-users may prefer to obtain information from non-public extension sources/channels; e.g., private-sector researchers, private consultants, field staffs of manufacturing industries, or other agricultural producers.

users and the public (Bennett 1990, 1992 (a), 1992 (b), and 1994).

The intent of the *publicly funded* (i.e., public sector) element of the overall complex is to generate and/or promote capacities and innovations that benefit the public more so than specific individuals (Bennett 1996).

Other elements of the overall complex, in addition to *intermediary users* and *end users*, are:

- the *private, commercial sector* that (a) generates and/or promotes capacities and innovations intended primarily to benefit individuals, and (b) markets these capacities and innovations for intended profit (e.g., *manufacturing industry* that generates and markets technologies for profit); and

- the *private, non-profit sector* that may focus on serving the public interest, as does the public sector, and also may focus on serving private interests, as does the commercial sector.

Both the public and the private sectors may *generate innovations* (through research and development), be *intermediary users* of them (through providing technical assistance or service, credit, and cost-sharing), or be *end-users* of them (through producing, processing, and consuming agricultural products).

The macro-stage model characterizes major, *generic roles*--as well as dozens of inter-relationships among them--within the overall complex. The model recommends ways to enhance cooperation and collaboration among the elements of the complex, with an aim to increase its *effectiveness and efficiency*.

Overview

An analogy may be drawn between a recirculating fountain and the macro-state model. The *portion* of the model that represents public-sector programming with and for users is graphically represented by Figure 3. Circulating action begins from the bottom of the Figure, then rises to the tops of Stages I, II and III, and finally cascades (re-circulates) to the bottom of the "fountain," via Stage IV.

Societal or community *conditions*--i.e., soci-cultural, economic, environmental, or other needs and resources--*drive action* at all four Stages; i.e., generation, refinement, diffusion, and utilization of innovative procedures and products.

*Use*s of public sector agency capacities and innovations (represented by the downward-flowing lines) are evaluated as to their positive and/or negative impacts on problematic situations (e.g., social, economic, environmental conditions) experienced by the public and users.

See Figure 3 [attached]

The Stages in the model are named after their respective accomplishments in the overall process (Bennett 1990, 21-59). Accomplishment of all the stages depends upon networking.

Stage I, "Establish Efficacy," of strengthened capacities and innovations is accomplished through research and development processes. Stage II, "Tests and Refines" emergent capacities and innovations is accomplished through adaptive research and related processes. Stages I and II represent the *research function* portrayed by the model.

The *extension function* of the model is represented by Stages III, i.e.: (a) "Promotes" tested capacities and innovations through conveying information about them and advocating their use; and (b) "Responds" to Users' *pro-active, self-directed* searches for project-based capacities and innovations.

Stage IV accomplishes "Utilization" first through users' positive judgments/appraisals of offered capacities and innovations. These positive appraisals lead to *use*. Evaluations in this stage are accomplished through examining (a) *usage* of promoted capacities and innovations, and (b) *consequences* flowing from such usage.

Program/project staffs and users continuously *assess and reassess conditions*, e.g., socio-cultural, economic, and environmental needs *and related resources* (at Stages I, II, III, and/or IV) in order to guide these stages. Staffs and users make these assessments and reassessments through various methods of *networking*. [15]

The dashed, wavy, vertical lines (Figure 3) that bound Stages I through III--separating them from Stage IV--represent a variety of soci-cultural, economic, and environmental *contextual factors*.

Contextual factors affect the development of projects at each of the first three stages of the macro-stage model. Such influence is depicted by the *diagonally upward arrows* leading from the wavy, vertical lines toward each of the Stages. Contextual factors also affect information and product flows from Stages I, II, and III (singly and collectively) into Stage IV. These flows, represented by the horizontal arrows passing between Stages I, II, III and Stage IV are affected by these factors.

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[15] Networking builds and maintains *awareness of conditions and trends* in order to help projects (a) assess needs and opportunities, (b) acquire resources, and (c) choose activities to discharge responsibilities. Public-sector researchers and extensionists are influenced by user associations as well as by the views of other public-sector agencies.

Networking includes five types of *communication* with and *participation* by stakeholders, including end-users of technologies and practices. Ranging from the international to the local levels, these five types of communication and participation include: inter-organizational, interpersonal, mass media, individualized electronic, and *ad hoc* (e.g., surveys and focus groups).

The mode and timing of *networking* with representatives of the public and users vary considerably between research and extension. *Mode:* in their development of technologies and practices, researchers generally interact with a somewhat different user network than do most extension personnel. Extension programs are heavily influenced by informal networks at the *county and multi-county levels*, whereas most research projects are less so (Lipman-Blumen and Schram 1984, III; Rogers et al. 1988, 12). *Timing:* extension programs may be conducted quickly following networking that identifies current and projected needs. However, months to years generally elapse between the time that researchers initially network to assess needs and the time that the resultant technologies and/or practices are ready for delivery to users.

Roles by Stage

Generic roles of research, extension, and users *within* the four macro-stages are identified *by stage* of the model (Figure 4).[16] Within the functions of agricultural research and extension, the advancement of *capacities* pertains principally to the strengthening and transfer of *knowledge*; and the advancement of *innovations* pertains principally to the improvement and transfer of group and individual *procedures* (e.g., policies, regulations, and practices), and material *products* (e.g., infrastructure and technologies[17]).

Fourteen generic roles are portrayed in Figure 4. *Networking*, a 15th role, including the conduct of needs assessments and formative evaluation, is not depicted because it *pervades* all four stages of the model--i.e., underlies the performance of *all the other roles* represented in the model. *Appraisal* of offered capacities and innovations, by users-- a 16th role within Stage IV--is not depicted in Figure 4 for lack of display space.

See Figure 4 [attached]

As indicated by Figure 4, research staffs and extension staffs *share* several of the roles identified; however, each type of staff *performs these shared roles in a distinctive manner*, as explained below.

Flows of information and influence between and among the generic roles of research and extension generally are "two-way" --i.e., flows course vertically, laterally, and diagonally. The two-way flows occur both *within* and *among* the four Stages.

Information and influence *rise* from Stage I to Stage II, then to Stage III. Information and influence in these Stages also tends to flow *diagonally upward* as well as flow laterally, from left-to-right (however, right-to-left flows also occur, especially between the roles of networking by extensionists and networking by researchers).

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[16] Public research and extension, industry, and intermediary users supplement and assist the roles performed by *end-users*, who perform *all* the generic roles identified by the macro-stage model (Bennett 1992 (a) and 1994). End-users tend to diminish their attention to Stage I-III roles, as these roles increasingly are performed by the other elements of the complex. This diminution permits end-users to further concentrate on pre-use *appraisal* of alternative technologies and practices, *use* of selected technologies and practices, and post-use *evaluation* of impacts of such use.

[17] *Technologies* incorporate information and skills into specific devices or products (e.g., agri-chemicals, machinery, and seed varieties). The information and skills encompassed by *management practices* (e.g., interpretation of weather forecasts and using commodity market reports) generally are *not* incorporated into devices or products. The information and skills encompassed by a practice facilitate users' specific observations, judgments, and behaviors (Bennett 1996; Chamala and Keith 1995; Clark et al. 1997, 42-48; Petheram and Clark 1998).

Practices may partially or fully substitute for use of *technologies* (e.g., using the practice of crop rotation rather than relying totally on commercial synthetic fertilizers). Also, practices may *optimize* the effectiveness, and/or *reduce* the risks, of using technologies (e.g., the practice of splitting into several, smaller applications the total annual application of commercial fertilizer to a crop).

Stage IV is characterized by *lateral and downward* flows, which includes representation of influences on soci-cultual, economic, environmental and/or other conditions. These final impacts, in turn, affect the manner of continuation of the operation of Stages I through IV.

I. Establish Efficacy

Informally, Stage I sometimes is called "proof-of-concept." In addition to the role of *networking*, the Stage includes *basic research* and *applied research* for development of knowledge, procedures, and products. Research staff *discover* scientifically-based knowledge, principles and processes, and create *invention*s (e.g., biological, chemical, mechanical, electronic and/or organizational).

In performing the role of developmental research--i.e., *developing*--researchers build upon both scientific principles and previous inventions to develop new and knowledge, technologies and practices.

Extension staffs may develop practices, and systems of practices and technologies. For example, extension staffs often participate--along with public-sector research, industry, and/or users--in developing new uses for electronic technologies in systems of production, protection, processing, and marketing of foods and fibers. Extension staffs also develop new curricula and methodologies for their transfer in performing educational roles.

Stage I provides part of the foundation for roles performed at later Stages in the model. However, Stage I may include a responsive extension function: research findings and developmental work may pass *directly* into use *without* reaching Stages II and III. Increasingly, large-scale intermediary and/or end-users pro-actively access/retrieve the latest research results of research and extension agencies. Such users' initiative in gaining access is suggested in Figure 4 by the curved arrows beginning from Users and looping past the identified roles of research and of extension.

II. Test and Refine

Stage II focuses on identifying the *degree* of efficacy under varied *conditions.* In addition to that of further *networking*, this Stage includes research function roles of *assessing* and *adapting* previously developed research and extension efforts.

Assessment tests applicable knowledge, technologies and practices for their economic, social, and environmental acceptability and feasibility of use. *Adapting* and *systemizing* entail adjusting and integrating technologies, practices, and organizational methodologies in order to improve their acceptability (e.g., relative to economic, soci-cultual, and environmental criteria).

Research staffs generally conduct *generic* assessment, adaptation, and systemization. Extension staffs conduct *site-specific* assessment, adaptation, and systemization--often in concert with research, industry, and/users (Office of Technology Assessment 1986, 265-266, 275-276).[18]

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[18] The role of systemizing is that of *combining* related technologies and practices into user-oriented ensembles and then assessing their effectiveness and impacts under realistic field conditions. Researchers generally devise generic systems in order to enhance agricultural

The *role of commercializing public-sector research outputs* entails financial marketing of (a) selected technologies and (b) associated information as well as advice. Firms are licenced to sell, to users, technologies and associated information that have been developed, fully or in part, by publicly-supported research efforts.

Commercialization is an *emerging role* for extension; this role entails *brokering commercial linkages* between public sector researchers and manufacturing/processing industries. Extension specialists often have frequent contact with commercial firms, and thus can recognize potential manufacturing and/or processing opportunities relative to new and emerging inventions (Chapman and Lohman 1987, 4).

Brokering applies an extension forte--i.e., *inter-organizational and interpersonal networking* (Segelkin 1986). Such networking serves to increase manufacturing and processing companies' awareness of opportunities to *commercialize* emerging research findings and technologies.

Insofar as research and extension staffs involve users in testing and refining technologies and practices and organizational methodologies (as in test-demonstrations), Stage II includes an extension function: i.e., there is *"push"* from Stage II toward Users. This push is suggested by the *straight, horizontal arrows* pointing toward Users. Likewise, in making manufacturing firms aware of commercialization opportunities, there is "outward push."

Increasingly, however, intermediary and/or end-users--especially those that are large-scale agri-businesses--*pro-actively access/retrieve* the latest results of research and of extension testing and refinement. Such "pull by users"--to appraise such capacities and innovations for possible use--is suggested in Figure 4 by the *curved arrows* beginning from Users and looping past the identified roles of research and of extension; the curved arrows represent a passive extension function.

Both in Australia and the U.S., the (Stage II) transition to user-friendliness and site-specific effectiveness of practices and technologies often is a *weak link* in the overall process of generation, diffusion, and use of agricultural and agriculturally-related technologies and practices (e.g., Feller et al. 1984, 124, 233-234; Nowak et al. 1997, 29-30; Rogers et al. 1988, 16-17):

One reason for the frequent weakness of Stage II is that it is neither in the "main stream" of university research; nor is it usually in the "main stream" of extension. *Frequent weakness in Stage II points to a specific need for collaborative projects.* Strong Stage II processes can provide for *effective linkages* between the research function and the extension function. It may be difficult to conceive of a project bridging across extension and research that does not include a strong Stage II.

III. Promote and Respond

Just as Stages I and II focus on the research function, Stage III focuses on the extension function, i.e., movement of applicable

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production, resource conservation, commodity marketing , and farm and family financial management. Extension staff generally *adapt* such generic systems to local conditions.

knowledge, technologies, and practices toward use. The Stage's roles include *free and/or user-fee transfer* of information and advice, as well as provision of *education*.

Project staffs *"push"* recommended practices and technologies[19] toward intermediary and end-users. Such "push" is depicted by the *straight arrows* pointing to Uses (Figure 4). In promoting innovations to users, i.e., project audiences, intended users may be segmented according to their predisposition to adopt innovations as well as their preferred channels of communication (Nowak et al. 1997).

In general, *public-sector* projects transfer information and adoption advice about *practices and systems* more so than about technologies. Also, public-sector projects provide *non-formal education,* which transcends the transfer of specific practices and technologies. As mentioned previously, education helps people to *understand and apply relevant principles and processes* toward appraising payoffs and risks of adapting and adopting alternative practices and technologies.

Education also enhances *accurate* selection and application of knowledge, technologies and practices. That is, education enhances use of the most cost-effective practices and technologies given users' precise needs, opportunities, and costs.

Research staffs often directly convey information they have generated to intermediary users other than extension staff, and also directly convey such information to end-users, in order to assure that it is quickly and appropriately adopted by the appropriate audience(s). Such transfers by researchers may be conducted in cooperation with extension professionals, or they may be conducted independently (e.g., as when researchers use internet hyperlinks to connect their disciplinary publications with accounts of how their research is being applied in a practical manner).

Extension staffs may perform the role of information/advice transfer as well as the role of education *directly*; or they may perform these roles indirectly--e.g., through coordinating presentations to users by disciplinary or inter-disciplinary researchers, commercial vendors, etc. (Coutts 1997).

Increasingly, *users' pro-actively* "pull" practices and technologies, i.e., *retrieve* generated knowledge, technologies and practices. Such *"pull"* is depicted by the horizontal, looped arrows; these move from users past the displayed research roles and extension roles (Figure 4).

IV. Utilize

Stage IV focuses on use, and results of use, of applicable knowledge, technologies, and practices. Here, *users* are *key actors*, as they

[19] Technologies and practices also are conveyed to end-users by non-extension/non-research agencies and organizations (i.e., manufacturing firms and a variety of intermediary users). Commercial firms, including private consultants *market* (for profit) technological products as well as information and advice regarding their use.

Non-extension intermediary users *assist* end-users in applying technologies and practices by providing free or user-fee *services*. Similarly, other intermediary users provide *loans, cost-sharing,* and *subsidies* to help users acquire technologies and systems. Regulatory intermediaries users inform users of relevant legal requirements regarding innovation use.

sometimes are in the first three stages (*users may perform, in various circumstances, all the roles identified in this interdependence model*). Users *focus* on applying relevant knowledge, technologies and practices to meet their own needs and those of the public--including economic, social, and/or environmental needs.

Users *judge/appraise the positive and negative values of adopting recommended practices and technologies* (e.g., Nowak et al. 1997, 12-15, 19-20). Users make these judgments primarily by observing impacts of usage experienced by other users who are similar to themselves, and by conducting their own tests of the cost-effectiveness of recommended practices and technologies. The role of appraisal is *not shown* in Figure 4 because of *space limitations* within the figure.

Major to Stage 4 is *end use* of knowledge, technologies and/or practices, in terms of extensiveness (i.e., incidence), duration, and frequency--as well as *accuracy* of use. End uses, and impacts of these uses, are evaluated not only by users, extensionists, and researchers--but also by public-interest groups, journalists, legislators, and the judiciary.

Most evaluations of extent of use, and impacts of use, are *informal*. These are made without explicit criteria and technically accurate evidence--e.g., by users, the general public, the media, and legislators. However, *formal* evaluations (using explicit criteria and evidence that meet technical standards) are becoming increasingly important.

Project contributions to the *use* of improved knowledge, technologies and practices and *impacts* of such use may be formally evaluated. Such evaluations are utilized to modify the performance of extension roles and research roles (Figure 4). They also are utilized to modify the public's degree of support for research and extension functions (Bennett 1990, 61-73).

Progressing through *all four stages* in the macro-stage model may require *lengthy* time-frames, i.e., as much as several years may be needed in order for users and the public to realize benefits from improved knowledge, technologies and practices (Hrubovcak, Vasavada and Aldy 1999; Nowak et al. 1997).

Implications for Collaboration

Collaborative projects require that all project staff *fully understand processes for the planning of extension roles* relative to project roles performed by researchers. Public-sector research roles generally are better understood, as well as better rewarded, than public-sector extension roles.[20]

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[20] Institutional rewards often favor research activities over extension activities, in *several ways*. First, researchers usually have greater opportunity for individual recognition through intra-agency and extramural funding, via a well-established peer-review system. Second, recognition of research is enhanced by the greater ease of delineating individual efforts and more readily quantifying evaluations of their work, through criteria such as numbers of publications and amounts of research-support dollars received. End-user behavior modifications achieved through extension programming generally are difficult, expensive, and time-consuming to validly document.

Even for university staff who carry primarily extension responsibilities, via joint

Thus, initiation of a collaborative effort is likely to entail posing several questions focusing on the extension function, including:

- "How and *when* will plans for the extension function of a collaborative project be established?"
- "Will the range of factors used in planning the extension effort be *as wide* as those encompassed by learning-system models?"
- "*Which role(s)* identified in the macro-stage model will extension staff perform, and will these include education as well as information transfer?"

Replies to the above questions will be based upon *the conceptual model*(s) that are explicitly or implicitly embraced by the administrators and programmatic staffs who encourage, propose, conduct, and/or fund collaborative projects.

There must be *due diligence in selecting appropriate conceptual model(s)* for collaborative projects; that is, research roles and extension roles may be arranged in such a way as to be counter-productive and/or unsustainable, relative to an aim of achieving collaboration. Two pointers based upon the foregoing principles follow.

First, success of the extension function in a collaborative project, as elsewhere, depends upon its *development via a learning-system approach* (which is incorporated into the new interdependence model). Second, projects that are truly integrated are likely to *emphasize Stage II* research and/or extension *roles*: at this Stage, generally speaking, the extension function and the research function must clearly overlap. Emphasis on Stage II can close gaps between generic research findings and the site-specific (e.g., on-farm) fine-tuning that these findings require for maximum usefulness to end-users (Feller et al. 1984, 124, 233-234).

Use of the macro-stage model facilitates selection of project *scope and role priorities* in Figure 4. It is anticipated that a research-extension team first will jointly develop an *overall plan-of-work* or *project proposal* that includes an *outline* of the work to be accomplished in Stages I, II, III, and/or IV (Figure 4). This will include general *plans* for extension efforts and research efforts, and their respective evaluations, within each Stage selected for the project.

A micro-step model is next introduced. This model is intended to guide general planning for *the generic roles of the macro-stages* selected for a project. The micro-step hierarchal model *elaborates how* each generic role for research and for extension may be connected to (a) socio-cultural, economic, environmental and/or other conditions to be addressed; (b) capacities and innovations to be developed and extended to users; and (c) the roles of users in obtaining these capacities and innovations and in using them in a practical manner.

Micro-Step Model

Beyond *comparable views* of how their respective *roles* can be linked, full collaboration between researchers and extensionists also requires comparable

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appointments, promotion and other external rewards may depend largely on research productivity and recognition.

views of how they can link *objectives* of their respective efforts. *Linkages* between a project's objectives for its extension function and its research function can be guided and strengthened by a *micro-step hierarchal model*. As demonstrated below, the model suggests a *comparability or parallelism* between research objectives and extension objectives in response to common needs and issues.

To the extent that extensionists and researchers both can employ the *hierarchal model for collaborative project planning and evaluation*, both should come to share similar viewpoints, expectations, and project language. Such sharing can help these staffs to articulate and merge their efforts in collaborative project planning, implementation, and evaluation-reporting.

Prototype

The hierarchal model for *both* planning *and* evaluating research *and* extension has a forerunner: i.e., a hierarchal model for evaluation of *extension* programs and projects (Figure 5, adapted from Bennett 1976).[21] The model shows a logical and empirically-suggested chain of events that characterizes general features of projects for conveying practical information to improve personal, socio-cultural, economic, environmental, and other conditions.

See Figure 5 [attached]

The means-end chain of objectives and evaluative criteria facilitates evaluation of the effectiveness of extension and similar "action" programs/projects in achieving desired end results.

Beginning at the lower left-hand corner of Figure 5, *inputs* (i.e., "Resources" used by a project) produce project *outputs*[22] (i.e., "Activities" that obtain information and convey it to "Participants"). Intended *outcomes* and/or *impacts*[23] may follow from these project outputs.

If "Reactions" of participants to their involvement in project activities are sufficiently positive, then participants may learn the project's subject-matter content and apply it in adopting/using project-recommended "Practices." As a result of such adoption/use, desired economic, environmental, personal, soci-cultural, and other "Conditions" may be attained.

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[21] Development of the hierarchal model for extension program evaluation was based squarely upon the seminal work of both Kirkpatrick (1967) and Suchman (1967).

[22] "Output" of an action program or project include opportunities, services and/or products it delivers to clientele (General Accounting Office 1998). Outputs include involvements of clientele in project processes; such project "reach" (Montague 1997) is deemed critical to the eventual achievement of benefits for project clientele and the public.

[23] "Outcome" is defined as the *combined* result of all closely related activities, products, services and/or influences. An outcome refers to the total amount of resultant *progress* (positive or negative) observed in a situation. "Impact" of a project/program is its *particular contribution* to an outcome, taking into account *any other* influences or contributions to the outcome (General Accounting Office 1998; Nowak et al. 1997; Perrin 1998; and Rosi et al. 1998).

The model is hierarchal in two ways. First, each successively higher level in the hierarchy potentially can provide stronger evidence of project accomplishments relative to identified, desired conditions. Second, the difficulty and cost of obtaining evidence of such project accomplishments generally increases as the hierarchy is ascended (Bennett 1976, 8-9).

In the U.S., the hierarchal model has been employed to provide guidance for numerous evaluations of local and state extension projects (e.g., Barstow 1996, 61-62; Spiegel and Leeds 1992). The model also has provided guidance for projects of other public sector agencies and private sector organizations, e.g., fish and wildlife agencies and agencies and nonprofit organizations that conduct environmental education (e.g., Norland 1999; Ricker 1998; Steelquist 1993; Washington State Department of Ecology 1996; and Wiltz 2000).

The hierarchal model also has spread internationally--e.g., to Australia, Canada, China, Lesotho, Finland, Nepal, and Uruguay.[24] The hierarchal model served as the principal framework for reporting accomplishments of a multi-national university consortium with projects in the Philippines, Burkina Faso, and Equador (Neely, Buenavista, and Earl 1999).

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[24] For example, see Agricultural Industries Team (1997); Boomsma et al. 1996; ;Mortiss (1993); Boyle (1981); Patton (1997, 221-223); van den Ban and Hawkins (1996); and Extension Group, World Bank (1998).

Evolution and Attributes

In 1995, the hierarchal evaluation model was generalized for *planning* as well as transmitting practical information (Bennett and Rockwell 1995; and Rockwell and Bennett 2000). In the present paper, the hierarchal model for planning and evaluation is *additionally generalized*.

The hierarchal model now is generalized to transcend its previous scope, i.e., information and education programs, and potentially applies to many types of programs and projects. The name of the newly generalized hierarchal model is abbreviated as the "HM" (Figure 6).

See Figure 6 [attached]

- It has been shown that the HM can apply to the *generation* of practical information; thus, the model may be used in planning and evaluating *research and development* as well as in planning and evaluating extension and other action programs and projects.

- Several levels of the HM are *re-named* (following the lead of Montague 2001) in order to make them applicable to *numerous substantive areas* such as medical research and treatment; constructing and operating transportation systems; developing regulations and taking regulatory actions; and developing and conducting programs for technical and financial assistance.

It is acknowledged that, beyond the HM itself, numerous *contextual factors* influence project development, performance, and evaluation (Figure 5 and Figure 6). In *project development*, contextual factors include stakeholder inputs; situations and trends; and previous research and evaluation findings.

Contextual factors regarding *project performance* are many, may be powerful, and may vary according to level in the hierarchy (Rockwell and Bennett 2000). Identification of the major contextual, i.e., *intervening factors*, bearing on extent of project performance moves a theoretical model, i.e., a partial theory, to a *program theory*. A *program/project theory* specifies contextual mechanisms, e.g., clientele and community characteristics, which permit predictions of *when*, *where, and how soon* a project is likely to be effective (Rogers 2000b; 2001; Weiss 2000).

Contextual factors in *project evaluation* include resources available for the evaluation, political constraints, etc. These factors go beyond the model which guides the evaluation in shaping its characteristics, reporting, and other uses.

The levels of the HM tend to occur in a linear progression, but the levels may *interact* with each other, e.g., occur concomitantly or synergistically. Thus, movements down and up the HM tend to be *reflexive*; i.e., proceed forward, then turn back, and then go forward again. These *"step-wise" feedback loops are necessary*–in order to establish project objectives and evaluation criteria, guide implementation of project plans, and evaluate outcomes of implementation (Funnel 2000, 92-96).

The HM is promoted relative to some other models because of its *efficiencies* and *"fit"* within multi-stage programming (e.g., Jordan 2000; Rogers et al. 2001).

- *Efficiency in Transition*. Because the HM employs the *same logic* (except in "reverse"direction) for planning a project as for evaluating it, separate planning and evaluation models are not needed--the HM simply is employed in opposite directions. For project planning, it employs an "if-then" logic that "*maps" from* types of intended impacts *toward* inputs needed to accomplish them. For project *evaluation,* the HM employs "if-then" logic that "*maps" from inputs toward* intended impacts. Although some models suggest or imply mapping from intended impacts toward needed resources, only a few *feature* this process for project planning.[25]

  Employing the same model both for planning and evaluating a project obviates converting the project's plan-of-work or proposal to a different model for guiding the project's evaluation. It is time-consuming and inefficient to use a planning model and evaluation model that differ from each other.

  Efficiency in Application. The HM also tends to be *immediately applicable* to planning and evaluating projects that entail generation and/or transmittal of practical information. This rapid applicability is due to the HM's

[25] See Northeast Region Sustainable Agriculture Research and Education (2001), Kaplan and Norton (1996), and Kaplan (2001).

intermediate position on a continuum of generality-specificity. [26]

On the one hand, the HM is *more substantive* (i.e., features a greater number of specific concepts) than are several other means-end schema--e.g., the Logical Framework (Coleman 1987) and framework of the U.S. Government Performance and Results Act (1993). The more substantive nature of the HM helps users to quickly recognize *connections* between the attributes needed by a particular project and the HM's *partial theory* of how projects generally can bring about desired impacts.

On the other hand, the HM is *less substantive* than are detailed, "custom-made" models (e.g., Mayeske 1999, 9-19) which construct "from scratch" a partial theory or theory of how a particular project can produce desired impacts. The relative generality of the HM can provide a substantive starting point for *rapid* construction of a specific theoretical model or theory for a particular project (e.g., McDonald 2000), usually without the labor-intensive requirements of a custom-built model.[27]

- *Fit within Macro-Stages:* The HM may be *nested* within multiple stage models (e.g., the macro-stage model). The importance of multiple-stage models is shown by Bennett (1994), McLaughlin and Jordan (1999), McDonald (2000), and Rogers (2001). Multiple-stage models encompass tandem efforts, where one program/project partner relays (i.e., "hands over") its accomplishments to another project/program partner, or collaborates with partners in more than one stage of programming. The partners have *linked* roles in producing, receiving, and/or utilizing outputs or impacts. Program/project partners *share* the responsibility for achieving longer-term, overall objectives (Earl, Carden, and Smutylo 2001).

  Multi-stage models help to determine *domains* of accountability, e.g., for research relative to extension efforts including commercial technology transfer. Specific accountability of an identified partner is confined to the domain in which it intends to be directly or indirectly *influential* in an overall process (Jordan 2000, 18).

Connections with Macro-Stage Model

Use of the macro-stage model followed by use of the micro-step hierarchal model (HM)

[26] A model having a similar position on the generality-specificity continuum is advanced by Taylor-Powell (1999), and Barkman and Machetes (2000). This model's six steps are similar to six of the seven levels of the HM, omitting the "Interests" level which is included in the HM.

[27] The HM often has been modified for particular uses. For example, additional levels beyond its usual seven levels have been added; concepts have been modified or rearranged; and individual level have been elaborated with additional, related variables, as needed to meet specific requirements of project staffs, evaluators, or stakeholders (e.g., as exemplified by McDonald 2000; Norland 1999; Westermarck 1998; and Wiltz 2000).

facilitates two major steps in collaborative projects, i.e.; (a) selection and articulation of *generic research roles and extension roles*; and (b) *choice of objectives* and *evaluative criteria* for the selected roles (these steps are summarized in Appendix III).

The HM can intersect with the macro-stage model in matrix fashion. In doing so, the HM can suggest a basis for *planning* and for *evaluating* the particular generic roles selected for a collaborative project. In using the "ladder" of the HM, it is essential to be clear about which "wall" the ladder rests against, i.e., to which role or cluster of roles the hierarchy is being applied.

For example, the "Processes" level of the HM, its second level, *can intersect with each* of the several roles selected for a project. In doing so, the names of selected roles, e.g., "adaptation" and "education" can be positioned to precede "Processes" in the hierarchy; thus, e.g., the HM can become applied to a project's "adaptation" processes and its "education" processes.

On the *left-hand side* of the HM, the "Processes" level represents *planning the processes* for the selected roles (e.g., selecting levels of objectives for the project's "adaptation" role and "education" role. On the *right-hand side* of the HM, the "Processes" level represents evaluation of *actual performance* of the selected roles (e.g., selection of evaluative criteria for the project's "adaptation" and "education" roles.

Uses in Planning and Evaluation

Project Planning Overview. The HM suggests that project planning first should identify intended project *impacts*; then *outputs* necessary to achieve these impacts; and finally *inputs* or investments necessary to produce the outputs. In following this "if-then" logic, project development *descends* the left-hand side of the HM.

Moving from *the top toward the bottom* of the left-hand side of the HM, planning research-extension projects begins with visioning improvements in *"Conditions"* (e.g., socio-cultural, personal, spiritual, safety and security, economic, and environmental conditions).[28] Making such improvements requires planning for the *generation* of *sought-after "Innovations"* and then *sufficient use* of the *generated and/or selected "Innovations"* — i.e., "processes" and/or "products" (as explained above).[29]

For the envisioned "Innovations" to be generated and then used so as to make the envisioned improvements in conditions, there must be plans for relevant *"Capacities"* to increase. Such capacity increase includes project staffs' learning *how to be able to generate* the desired "Innovations;" increased "capacities" also includes project audiences' learning *how to apply* the innovative products and procedures.

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[28] While in many cases it is ideal to initiate program or project development at the top level in the hierarchy, is not always necessary or prudent. The logical direction of planning is *descent*, regardless of the particular hierarchal level at which planning is initiated.

[29] "Innovation" may be seen *objectively* as something that is new to all in society; or it may be seen *subjectively* as something not generally new, but new to an individual or group.

Increase in relevant Capacities must be based on plans to serve a broad range of *"Interests"* held by those intended for "Involvements" in project research and extension *"Processes."* That is, project processes must seek to build upon a range of identified interests[30] that will *motivate*:

(a) research cooperators to sustain their project involvements long enough for project staff and cooperators to increase their respective, requisite Capacities to generate Innovations; and (b) extension cooperators and participants to sustain their project involvements long enough to acquire the requisite Capacities to use the Innovations.

Project "Processes" must be chosen that will effectively recruit and guide appropriate "Involvements" as well as foster acquisition of the requisite "Capacities." Finally, for such "Processes" to be conducted, there must be plans to allocate sufficient *"Resources"* to conduct the Processes.

Project Evaluation Overview. The HM suggests that *evaluation of project performance* first should assess *inputs* and their production of *outputs*; then assess the extent to which these outputs achieved intended *impacts*. Project evaluation *ascends* the right-hand side of the HM, generally following the "if-then" logic of project implementation.

Moving from the *bottom toward the top* of the right-hand side of the HM, project evaluation begins with assessment of whether *"Resources"* allocated to the project have been sufficient to conduct the selected research and extension *"Processes?"* Next, there is assessment of whether the Processes have elicited adequate *"Involvements"* of cooperators and/or audiences?

Then, there is examination of whether project staffs', cooperators' and participants' *"Interests"* in the Processes and their Involvements have motivate their continued *"Involvements,"* (so as to enable them to interact long enough to acquire their respectively needed *"Capacities)?"*

The next step is determining the extent to which requisite Capacities have been acquired. Then comes assessment of whether there have been individual and collective *applications* of Capacities (by project staff) to *develop* sought-after "*Innovations"* and (by participants) to *use* such Innovations?

Finally, it is enquired as to whether the extent of development and use of the Innovations has achieved the sought after *"Conditions*," i.e., brought about the

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[30] "Interests" here refers to a much broader set of interests than simply those regarding the particular capacities, innovations, and conditions which are targeted for improvement. The "Interests" level also includes cooperators' and participants' preferences and requirements for form, timing, and social as well as physical ecology of their Involvements in project Processes (Kirkpatrick 1987).

For example, extent of participant involvement in a project's processes may depend upon participants' interests in the personalities of project leaders, the information technologies used by project activities, the characteristics of other participants, and the timing and physical surroundings of the Processes. These interests may be as important to motivating involvements in a project as are interests in the particular research and/or educational aims of the project.

ultimate economic, socio-cultural, environmental or other aims for the project?

Uses in Collaborative Projects

Planning for and *evaluation-reporting* of collaborative research-extension projects *may be guided by the HM.* A collaborative team engages in *joint selection* of research objectives and extension objectives at as many of the levels of the HM as feasible. The extension-research team then *selects types of evidence* for evaluation of project effectiveness at these levels. Planning for obtaining evaluative evidence should and can occur simultaneously with planning for research and extension functions of a project.

The joint selection of objectives and evaluative evidence establishes *explicit integration* of planning and evaluation of research and extension functions. Finally, the team jointly prepares an integrated report of project accomplishments based on the evaluative evidence.

Planning Use

Use of the hierarchal model in project planning *assumes involvement of multiple stakeholders; the use of information based on situational and trend data*; *and use of project-related research as well as relevant program evaluations*. These sources of influence and information are employed to assess needs/requirements and opportunities, at the HM's seven levels (Figure 6).

Although there is joint, initial selection of objectives for both the research and the extension functions, the "time lag" between research implementation and extension implementation must be addressed. Project staff performing extension roles may fruitfully utilize such a time lag to: (a) *strengthen audiences' "background" Capacities* so that they will more fully understand, appreciate, and be able to use the envisioned research results when they become available; (b) conduct baseline measurements and segment audiences; (c) plan for conducting any needed site-specific testing and refinement of the innovative technologies and practices; and (d) plan for conveyance of research findings to project audiences. This advanced planning can facilitate a *seamless relay* of new/improved knowledge, technologies and practices from research efforts, through extension efforts, to users.

Collaborative teams may *integrate* project plans via *joint* descent of the steps in the hierarchy (see Figures 7 and 8) as presented in a later section of this paper. Development of collaborative research and extension objectives, or targets, (Rockwell and Bennett 2000) is explained below. Explanation includes reference to the overlapping *roles of research and extension* that are identified in the macro-stage model (Figure 4).

Conditions:

Development of collaborative research and extension generally is based on a *vision shared* by policy makers, researchers, extensionists, other experts, advisory group(s), other public sector agencies and private sector organizations, and other stakeholders. The joint vision entails *improving* identified conditions (e.g., socio-cultural, personal, economic, and/or environmental conditions) within a foreseeable time frame (Figure 6, top left).

It is essential that *research-extension teams* network with, and meaningfully involve in project development, stakeholder/advisory groups representing the public as well as intermediary and end-users of the envisioned technologies and practices: these persons should be involved in describing vividly the appearance of ultimate success, within relevant communities and among individual end-users.

Selection of *which* and *whose* conditions to improve depends upon several factors: the assessment of such needs is based on *value priorities*--which never can be totally achieved (Westermarck 1998), including issues of public benefits relative to private benefits (Bennett 1996); utilization of previous research results and program evaluations; and opportunities including resource availability. Information on socio-economic trends, e*x ante* evaluations, and peer reviews also helps to identify the economic, environmental, social, and other values to be realized by alternative, potential project impacts.

Objectives for improvements in the selected soci-cultural, economic, environmental and/or other conditions are set by judging *how much* improvement the project can make during a given time frame (Rockwell and Bennett 2000; Westermarck 1998) toward achieving the vision of what may be or should be. Objectives for improvements in selected conditions are to be achieved as a result of widespread *use* of the innovations that projects are to develop, modify, and/or promote for use.

Innovations:

In order to improve the identified conditions, research-extension teams, other experts, advisory groups and other stakeholders together *set priorities for* research-based *development* and/or *improvement* of *technologies and practices* for use by identified types of users. The end-users and intermediary users to be involved in the linked research-extension-education programming should be *jointly selected* by collaborating researchers, extensionists, and advisory groups. User segments differing in need for and/or receptivity to the types of practices and/or technologies envisioned for development and/or promotion should be defined, and plans should be made relative to such segmentation (Nowak et al. 1997, 40-41).

Extension-research teams, other experts, advisory groups and other stakeholders *together target envisioned* rates of adoption--by specified sizes of audiences--of the "Innovations," e.g., technologies and practices, that are to be developed or improved--and/or have already been developed and/or improved--through research activities.

Rates of adoption during the plan-of-work period are to be *accelerated* through extension projects that transfer recommended practices and technologies to end-users directly, as well as indirectly via related public and private-sector channels of influence (i.e., other intermediary users). Extensionists may *plan* for *preparing* intended audiences to consider *the emergent* practices and technologies, as soon as they become available to be transferred.

Capacities:

Knowledge--including theories and generalized knowledge is *targeted* for acquisition through the conduct of research (which may entail making discoveries and inventions through basic research). The new knowledge is necessary for (a) developing the envisioned innovations; (b) making improvements in existing technologies and practices; as well as (c) providing the basis for motivation by intended users to adopt the new or improved technologies or practices. Such new knowledge (K) should be influential in changing research and extension staffs' *attitudes* (A), *skills* (S), and *aspirations* (A) regarding the envisioned technologies and practices and their uses.

These "KASAs" targeted for acquisition through research, including any adaptive research by extension staff, should provide a basis for clienteles' consideration and adoption of the new, or newly improved, recommended practices and technologies. Extension and research staffs project the numbers and proportion of intended users who are expected, within an identified time period, to *become aware of, familiar with, and accept* (a) the newly improved, research-based KASAs as well as (b) the "background" KASA that are necessary for clientele to fully understand, appreciate, and use the envisioned research results when they become available.

Extensionists suggest plans for specific numbers and proportions of intended users and the public to learn *principles* and *processes* ("fundamental Ks") that are relevant to the consideration and adoption of the new or newly improved technologies or practices. Comprehending these principles and processes should improve users' and the public's assessments of--and decisions regarding the use of--the innovations that are to be developed and/or improved and then recommended for adoption or use.

Interests:

Interests in involvement in project processes--e.g., positive reactions to project leaders, project activities, and the total environment of project processes and participation--are anticipated from the *types of cooperators* to be involved in the research and extension programming (recognizing that some stakeholders and cooperators may be involved in both functions). Positive reactions also are anticipated from project *audiences*--i.e., the *types of participants* to be involved by the project's extension efforts.

Reactions are projected that, if realized, will ensure an appropriate extent of *involvements* in the related research activities and extension activities. Appropriate types and amounts of cooperator participation in the project's research function tend to enhance the appropriate development and refinement of relevant and acceptable KASAs, practices and technologies. Positive reactions by extension audiences, to their participation in the extension function, tends to increase their extent of learning of identified KASAs, and rates of adoption of identified practices and technologies.

Involvements:

Types and numbers/proportions of stakeholders, including intermediary as well as end-user audiences, are targeted to help *generate, test, promote* and/or *use* the identified innovations. Types and numbers of research cooperators are selected to help establish efficacy, i.e., develop desired generic innovations. Cooperators may include end-users, especially as they are involved in *testing and refinement*--e.g., adaptation and systemization--at generic and site-specific levels.

Types and numbers of *clienteles* also are targeted to participate in extension transfer and/or educational activities. The intent is to influence these audiences' general and specific KASAs so they can apply them to the consideration, adoption, and adaptation of recommended practices and technologies. A *sufficient proportion* of the audiences must adopt the recommended practices, and adopt them to a sufficient degree, in order to bring about charted improvements in collective soci-cultual, economic, environmental and/or other conditions.

Processes:

Research activities are *selected* including priority methodologies, modes of data generation, analysis and interpretation. The planned activities are aimed at *proof-of-concept* (e.g., efficacious development of an invention) and/or *testing and refinement* (e.g., adaptation of an invention to improve its efficiency).

Research impacts that are anticipated from conducting the targeted activities include modified knowledge, attitudes, skills, and aspirations *of researchers* relative to the envisioned type(s) of knowledge, practices, and/or technologies. Researchers also may plan to conduct information-transfer activities in order to communicate directly with intended intermediary and end-users.

Types and numbers of extension *activities* are selected relative to the new or newly improved, research-based management practices or technologies. Activities are selected to conduct site-specific testing and/or promotion for adoption by users. Such planning also anticipates processes to prepare subject-matter content and select extension methodologies (e.g., field demonstrations and media use) for use in *information transfer* and *educational* efforts.

Intent of such processes is to diffuse the relevant information among intended users. Information and education are planned in such a way that participants will change their respective KASAs, enabling consideration and accurate adoption--where useful--of the newly developed, or improved, recommended innovations.

Resources:

Necessary personnel, equipment, services, and operating budget are planned for, acquired and allocated in order to conduct the project's envisioned research and extension processes. Personnel resources are allocated in terms of the time, money, and staff qualifications intended for *planning, promoting, implementing, and evaluating and reporting* projects.

The needed types and amounts of resources are allocated in order to: develop and utilize research-based publications and other materials and processes for information transfer and education; and cover needed organizational maintenance, communication technologies, and transportation. Project resources are acquired from public-sector allocations--on the basis of formula, merit, or competition--and/or from private-sector sources.

There may not be need to initiate planning at the top level of the hierarchal model. Needs for use of the model vary. For example, the conditions and innovations to be addressed may have been established by policy makers. If these are deemed to be adequately defined, then planning may begin upon such a base, i.e., begin at the Innovations level.

The hierarchal model may be used to evaluate the project plan. Does the plan address the major steps necessary to achieve its impact objectives? For example, are the specific Interests of cooperators and/or audience that are expected to motivate their participation in the project adequately identified and linked into the plan?

Evaluation Use

Use of the hierarchal model (HM) to assess project performance (Figure 6) may involve stakeholders in acquiring and/or interpreting relevant evidence.

The HM's seven levels are *ascended* when assessing effectiveness and efficiency of programming. Levels in the hierarchy are discussed below in terms of *evidence* that might be collected for two approaches to evaluating project performance: i.e., evaluation of *the processes*[31] of conducting projects; and (in a sequential fashion)

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[31] Process evaluation is based on data regarding project-implementation (i.e., hierarchal model levels one through three). The primary purpose of process evaluation is to encourage on-going project implementation adjustments so as to ensure achievement of intended impacts.

evaluation of *project impacts*[32] (Larson and Svendsen 1996).

The HM's application to collaborative project performance and its evaluation (below) includes *reference to generic research roles and extension roles* that the macro-stage model identifies (Figure 4).

Resources:

In collaborative project performance (Figure 6, right-side), have designated *resources* been expended to support the planned research and extension processes? Have these resources covered the costs of personnel, equipment, services obtained, operating budget, etc.? Have resources been spent to persuade necessary *cooperator and audience participation* in project research and extension processes, including participation by both intermediary and end-user audiences?

Evidence regarding *actual* types and amounts of allocations and expenditures relative to *resources targeted* for the project may include: observation of amounts of staff time expended on project assignments; extent to which dollars allocated to the project are entirely expended and sufficient; avoidance of cost overruns; and leveraging of additional financial contributions to the project.

Processes:

Have planned (and previously unplanned) *research* processes been implemented--for *establishing efficacy* (e.g., technology and practice development) and/or *testing and refinement* (e.g., systemization of applicable knowledge, technologies and practices)? Have research priorities and research designs been followed, data are collected, and analysis and interpretation taken place? Have researchers performed an extension function, *transferring research-based information directly* to intended intermediary and end-users?

Have planned (and previously unplanned) *extension site-specific testing and refinement* of management practices been conducted? Have extensionists--in consultation with researchers, cooperators, advisory groups and other stakeholders--promoted adoption of the new or improved, research-based technologies and practices? Has there been both *education* and *transfer* regarding subject-matter content? Have planned methods (e.g., test-demonstrations, group process, and media use) for transferring and providing education about the selected subject-matter content been implemented and evaluated?

Evaluative evidence relative to the *processes' level* may include comparing observations of activity leadership and methods with targets set for them. Such evidence may include reports of the manner in which activities were conducted (including their number, frequency, intensity and duration), and the extent to which activities were completed as planned.

Involvements:

Have targeted stakeholders--including representatives of intermediary as well as end-user cooperators--*provided inputs* into researchers' processes, i.e., into their development, adaptation and systemization of innovations? Likewise, have the targeted intermediary and end-user cooperators provided extensionists' with inputs to *site-specific* assessment, adaptation and systemization of knowledge, practices and technologies?

Have the targeted types and numbers, as well as proportions, of *clientele* been involved--in extension events and communication channels--

[32] Impact evaluation examines degree of *project contribution* to outcomes at the fourth, fifth, sixth, and/or seventh levels in the hierarchy. Estimating project contributions to observed outcomes requires evidence about their links with project processes.

in order to change these audiences' awareness as well as knowledge, attitudes, skills, and aspirations (KASAs)? Have the clienteles been encouraged to apply these changes when considering the adoption of recommended practices and technologies?

Evaluative evidence relative to the *involvements level* may include observations of extensiveness, frequency, intensity, and duration of involvement in research processes and extension processes. Such evidence is collected relative to the targeted types and numbers/proportions of cooperators, intermediary users, end-users, and other stakeholders.

Interests:

Have research cooperators been sufficiently *interested* in the total array of project research processes, and their involvements in them, to motivate their help in developing, assessing, adapting, and systemizing the targeted innovations? Likewise, have cooperators been sufficiently interested in their involvement in the total array of project extension activities to motivate their help in testing, adapting, and systemizing research-based applicable knowledge, practices and technologies, as needed at specific locations?

Have *interests* of clienteles (i.e., intermediary users' and end-users') in project extension processes and their involvements in them--including interests in the subject-matter content conveyed--been sufficiently positive? Positive reactions by clientele are necessary to bring about their *continued* interaction with project staffs, to enable the necessary extent and rate of (a) clientele learning of relevant KASAs, well as (b) their adoption of recommended practices and technologies?

Evaluative *evidence regarding interests in / reactions to* project processes and involvements in them may include several types of data. These include: (a) observations of participants' attention to project activities and/or (b) participants' ratings of anticipated benefits from project outputs.

Capacities:

Through research processes, have *project researchers* gained capacities in terms of the knowledge, attitudes, skills, and aspirations (KASAs) needed to (a) develop the envisioned *technologies and practices* and/or (b) assess, adapt, and systemize them for use. Have *project extensionists also* gained capacities in terms of knowledge, attitudes, skills, and aspirations (KASAs) that are needed to assess, adapt, and systemize the strengthened technologies and practices for *site-specific* use*?*

Have participants in extension processes and other intended users correspondingly modified their awareness of the improved, recommended innovations, and their KASAs regarding them? Have the people involved in project processes applied their learning to consideration and adoption of project-recommended innovations?

Have extensionists *educated* intended users and the public so that they can comprehend and apply relevant, basic principles and processes ("fundamental Ks") in considering the adoption or use of specific practices and technologies? Has such comprehension and application helped these audiences to improve their decisions regarding adoption of the new/improved practices and technologies? (Education relevant to the new or improved technologies or practices may fruitfully precede the transfer of specific information about these recommended innovations.)

Evaluative evidence *relative to acquisition and application of KASAs* may entail the use of several types of data. These include validated measurement scales, i.e., objective indicators of KASA changes, and/or self-ratings by project participants of their KASA change.

Innovations:

Have researchers--in consultation with extensionists, advisory groups and other stakeholders--*developed* improved *technologies and/or practices* for use by identified types of end-users?

Are extension clienteles *prepared* to understand and consider for adoption *the emergent* practices and technologies? Have rates of innovation adoption among the targeted audience types been *accelerated* through extension processes?

To what extent have extension clienteles adopted new or improved practices and technologies *directly* from extension staff? To what extent have extension clienteles adopted new or improved practices and technologies *indirectly* through related public and private-sector channels of influence (media and other intermediary users)? Are recommended practices and technologies spreading within clientele groups as end-users observe their peers receiving net benefits from use of the improved practices and technologies?

Obtaining evidence relative to *practice change* may entail structured, *direct observation*. Such observation can help to rate progress in developing practices and technologies, and extent of movement of audiences through stages in the process of adoption of practices and technologies.

Alternatively, *subjective indicators* may be employed. For example, data may consist of self-reports by extension audience members as to their extent of movement through stages in the process of adoption of practices and technologies (e.g., Nowak et al. 1997).

Conditions:

Have research and development processes calculated or estimated changes in soci-cultual, economic, environmental and/or other conditions that *are expected* to accrue to various categories of users and the public as a *result* of differing degrees of user adoption of the project-recommended technologies/practices?

If increasing proportions of audiences are using and/or supporting the use of project-promoted innovations, are *actual* conditions becoming more in line with those *initially targeted* by research and extension staffs in concert with stakeholders? Have research/extension staffs calculated or estimated net social, economic, and environmental benefits that *actually* have accrued to (a) various categories of users through their adoption of research-based recommendations; and (b) the public as a *result* of user adoption?

Evaluative evidence relative to intended and unintended changes in identified conditions may include data from *objective indicators* such as changes in life expectancies, profit-loss statements, returns on investments, and indices of environmental quality. Evidence also may entail monitoring or evaluating trends in expressed *satisfaction* by end-users and the public relative to personal health, economic status, environmental quality, and the like.

One basis for calculating or estimating the conditions resulting from collaborative programming is to extrapolate from any past evaluations that have examined research-extension impacts on the adoption of related technologies and practices.

It often is not necessary nor feasible to proceed to the top level in the hierarchy in evaluating performance of a project. An ideal evaluation of project impacts would be to evaluate the extent that the desired conditions are achieved, plus assess any significant side effects. However, the difficulty and cost of obtaining evidence on project/program accomplishments generally increases as the hierarchy is ascended (Bennett 1976, 9). Depending upon the evaluative questions being posed, and the resources available for an evaluation, collection of evidence of effectiveness may not begin at the lowest level of the hierarchy, and/or may ascend only part way up the hierarchy.

Similar to other models, the HM oversimplifies reality; and actual events in programming do not always proceed in accordance with the framework. For example, project participants have degrees of *Interests* in marketed *Processes prior to* their participation in them, as well as during and following such participation. Also, there may be feedback from the extension function to the research function *at each* individual level of the HM, not just at the top level as depicted in Figure 6.

Reporting Use

Use of the HM in characterizing the *nature and impacts* of linked research and extension functions is illustrated below (Table 2). Comparability--i.e., a conceptual parallelism--of research and extension programming is asserted and described within the rows in the Table.

See Table 2 [attached]

Table 2 should facilitate a rapid grasp of hierarchal *similarities* between performance of the research function and the extension function. The Table briefly characterizes the types of information that might be included in a report on *linked* research and extension performance. The Tale also depicts the influence of research on extension--and the time lag that occurs between implementation of the two functions in a collaborative project. Such influence and time lag is depicted in the Table by the lines flowing downward and diagonally to the right--from impacts of research (i.e., on interests, capacities, innovations, and conditions) into resources and processes of extension (emulating the graphical presentation style of McLaughlin and Jordan 1999).

Compared with Table 2, the actual reporting on accomplishments of collaborative projects blends and overlaps. As shown by the *overlap* of programmatic roles in the macro-stage model presented above (Figure 4), the accomplishments of research objectives and of extension objectives in collaborative projects usually are not discrete, although they may be so in some cases.

Although portrayed separately in Table 2 (for the sake of demonstrating a parallelism between research and extension), there is in fact *sharing* by, and overlap across, extension and research performances.

Examples of Model Use

Numerous examples of previous use of the HM in *extension* project/program planning and performance evaluations exist (e.g., Rivera et al. 1983; Rennecamp 1995). By contrast, the HM has only begun to be used in planning and evaluating projects that include a research function. Below are two examples of HM use in *setting project objectives* linked across research and extension functions, and planning *evaluation of their linked performance*.

Although the HM appears to be applicable to *formal* education as well as non-formal, its potential for planning and evaluating academic programs is not probed herein. (As mentioned below, the paper is based on the view that any inclusion of higher education roles in collaborative projects aimed at non-academic audiences should be supportive of research and extension roles.

Legume Crediting Program

The first example is a simple, *hypothetical* one for the purpose of clarity of illustration. It spans roles within all four stages in the macro-stage model (i.e., the roles of development, testing, conveyance and utilization). This example, Table 3, focuses on development and diffusion of improved *practices;* i.e., research-based information and skills *not* incorporated into devices or products. Users put practices into

See Table 3 [attached]

operation through developing and exercising strengthened powers of *observations, judgment, and behavior*.

Table 3 illustrates use of the HM in planning and evaluation of:

- *development* and *testing* of recommendations concerning *granting legume credits* when determining rates of commercial *N* fertilizer to apply to crops, and
- *extent of increase in adoption rate* of these recommendations.

The example presupposes adequate involvement of stakeholders (including advisory boards and crop associations)--along with utilization of past research and evaluations--in setting project objectives, and in implementing and evaluating performance of the project.

Cattle Gene Marking Program

The second illustration of HM use is an *actual example*. It is more complex and wide-ranging than is the first, citing *discovery* and *invention* roles represented in the macro-stage model. The illustration reflects a 1999 program plan within Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO). The plan was a national program plan, i.e., it included cooperation with several state extension services as well as with the commercial sector.

See Table 4 [attached]

The case (Table 4) illustrates use of the HM in planning and evaluation of:

- *development* and *refinement* of gene (DNA) marker technology and associated practices for predicting marbling in beef cattle meat;
- recruitment of commercial firm(s) to manufacture gene marker test kits and provide gene marking services; and
- extent of DNA marker *adoption* as well as impacts of such adoption.

The marker helps select particular beef animals for breeding and for feedlot entry, with aim to improve the quality and competitiveness of beef meat.

The example as presented presupposes adequate involvements of project stakeholders (including advisory boards and cattlemen's associations) in setting program objectives, implementing the program, and evaluating its performance.

The illustration in Table 4 *does not* describe the *current* status of the CSIRO gene marker program, but rather the utility of the hierarchal model in planning and evaluating the gene marker program.[33] Research and development of the gene marker technology already has been completed; practices for producers' use of the technology are being refined; and "promotion" and "response," and "use" --macro-stage model-- have begun, e.g., beef cattle are beginning to be marketed on the basis of their DNA characteristics (Young 2001).

Efforts to promote the continued diffusion of this gene marker system are being driven by demonstrated economic returns at the farm level. Continued positive, significant returns to early users of the gene marker system will increasingly motivate *commercial extensionists* to transfer the system to other users.

Water Quality Project Review

Appendix I supplements the two foregoing examples of use of the HM. The Appendix provides a *post hoc* perspective on advantages that likely would have accrued to the Lake Manatee (Florida) Water Quality Demonstration, had project staff used the planning and evaluation approach promoted by this paper. The Lake Manatee Project joined efforts by University of Florida extension, research, and teaching staffs with efforts by two USDA agencies during the early - to mid-1990's.

[See Appendix I]

[33] Table 4 describes the original plan for implementation and evaluation; the Table is not intended to reflect changes in the plan since 1999.

The Lake Manatee project incorporated many of the features of collaborative extension and research that are described in this paper. Appendix I addresses how the planning, implementation, and evaluation of the project might have been enhanced had they been based on the models presented.

Systemization Across Projects

By their nature as *discrete efforts, collaborative projects* are likely to have objectives to develop, refine, and increase use of a *narrow range* of innovations (e.g., technologies and practices) in order to achieve identified improvements in selected conditions. Thus, a collaborative project may build a *short-term, specialized* extension function designed to achieve *focused* impacts. Over the long-run, however, in order to maximize effectiveness in assisting end-users and the public, the "Innovations" promoted for adoption by the *specialized* extension efforts of collaborative projects should be *systemized across projects* for inclusion in extension programs.

In this context, "systemized" refers to (a) *combining* related technologies and practices into user-oriented *ensembles* (i.e., systems) and (b) testing these ensembles' effectiveness, profitability, and soci-cultual and environmental impacts. Combining tested technologies and practices into effective *systems* is essential when helping users to efficiently cope with complex problems (Bohlen and Lucas 1984).

Systemization is increasingly needed because of growth of specialized research and extension efforts within governmental agencies and universities. It is recommended that extension staffs increasingly integrate technology and practice systems for financial management, commodity marketing, and production/environmental protection (Jennings 1986). It is further recommended that extension staffs increasingly involve end users, associations of end-users, industrial firms, and intermediary users (such as private agricultural consultants) throughout the process of systemizing technologies and practices (Wolek 1989).

As information about technologies and practices is systemized *across* projects, over time, it forms the subject-matter content for *extension programs* (as well as for *college teaching curricula)*. Extension programs generally include a *sequence* of information transfer and educational activities that collectively employ numerous methodologies.[34] The sequenced activities or events are designed to hasten consideration and adoption of recommended innovations, thereby improving social, personal, economic, environmental and/or other conditions.

Each event in an extension program is designed to contribute logically and psychologically to other events; events build upon each other as the program is implemented. The *sequence* of events designed for a program may continue for as long as several years.

A program's duration depends upon the length of time required to help selected audiences move through stages of *the adoption process*--i.e., the stages of "awareness," "interest," "evaluation," "trial," and "adoption" (Rogers 1995).

Take, for example, extension environmental programs (and other extension programs that promote research-based technologies and practices generally offering limited or uncertain economic incentives). In such programs, a considerable length of time may be required for widespread, *voluntary* adoption of recommended practices (Hrubovcak et al. 1999; Ribaudo 1997). Some evaluations have examined the time required for a *majority of* agricultural producers in a project area to adopt recommended innovations that protect or improve water quality: the time required may be up to six to eight years, or even longer (Nowak et al. 1997, 37-38).

A plethora of poorly-connected extension efforts may occur--in both the Australian and American contexts--if extension *programs* are *displaced* by collaborative projects (compared with programs, *projects*--by their very nature--tend to be *narrowly* focused). If only weakly connected, narrow extension efforts occur, then strengthening linkages *between* research and extension functions, through collaborative projects, will have the consequence of introducing *inefficiencies across* broader extension efforts.

Individual, collaborative projects' extension efforts may be disparate, small, and fragmented. Without systemization *across* projects, there is risk that such specialized

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[34] Types of methodologies include: *mass communication* (e.g., articles in farm magazines, television spots, radio shows, and newspaper articles); *controlled media* (e.g., computer- assisted information delivery, mailed newsletters, brochures and flyers); *group meetings* (e.g., with program cooperators and clientele); *demonstrations* (e.g., test-demonstrations, result demonstrations, field days and tours); *personal contacts* (e.g., telephone contacts and farm visits); and events at *public gatherings* such as fairs.

extension efforts will lack the critical mass necessary to undergo effective development and evaluation.

Moreover, without the type of systemization recommended by this paper, major segments of users are likely to be overwhelmed by, or find gaps in, a multitude of unconnected, duplicated, and/or conflicting extension recommendations; and users also will be understandably confused about *which* extension-promoted innovations will deliver the greatest cost-benefit to them (Bohlen and Lucas 1984; Jennings 1986).

Over time, there should be systemization *across* collaborative projects *that are identified as complementary to each other*. This can avoid fragmentation of project outputs and impacts relative to the informational needs of users.

End-users have only a limited amount of time in which to select among competing technologies, practices, and systems of technologies and practices. To the extent that extension efforts are tailored only to promoting the use of specific research results, lack of integration of *related* recommendations *across extension* efforts will waste the resources both of end-users and public-sector agencies.

Roles for Higher Education

The scope of this paper includes the development, testing, and *rapid* as well as *widespread* promotion for use of research-based knowledge, technologies and practices. The paper therefore views any collaborations with higher education as primarily supportive roles of extension and/or research within projects intended for broad, public participation and impact.

Academic faculty and students in collaborative projects can bring "cutting-edge" concepts and techniques to specific functions of research and of extension. Performance of project roles can benefit from faculty and student expertise. Student participation in collaborative projects can contribute to cost-effective staffing.

In particular, "third party" formal evaluations of needs for projects and of their degree of effectiveness are frequently needed. Internal evaluations--i.e., those conducted by evaluators employed by the research and/or extension agencies conducting a project--can lack credibility with policy makers and funding bodies. Academic staff can perform *external* evaluations of project planning and implementation processes, as well as of project outputs and impacts.

Early involvement of academic staff in planning for project evaluation likely will contribute to enhanced objectivity and credibility of project evaluations. Such evaluations provide important potential topics and data sources for theses and dissertations.

Use of project evaluations in external *accountability* may be achieved along with their use to improve project performance. *Objectivity* of external, academic evaluations may be combined with *insights for project improvement* that are more likely to come from internal evaluations (Barley and Jenness 1993; Bennett 1984).

Benefits from collaborating in research-extension projects *also may obtain* for both college faculty members and students. Academic involvements in collaborative projects can provide intellectual and skill development as well as grounded experiences that supplement and complement classroom, on-line, and other approaches to academic learning. College faculty members and students can benefit from the "real life," validity-testing experiences of project development, implementation, and evaluation.

Two examples are as follows: (a) college students and graduates increasingly find competitive advantage through having had *practical experience* in their chosen field (e.g., through collaborative experiences); and (b) as for-credit distance education increases, teaching faculty increasingly may rely upon clientele involvement techniques that they learn through collaborating with extension efforts. In addition, students' earnings as project staff members can sometimes help to finance their formal education.

It is hoped that other authors may find reason to build upon this paper in order to conceptualize the inter-relations among the functions of higher education, research and extension in collaborative programming.

Evaluation of Project Performance

Evaluation of performance of research-extension projects includes providing *feedback* on (a) generation, testing, and conveyance of project innovations; (b) extension audience *capacity to use*, as well as their *extent of use of*, project innovations; and (c) results -- positive and negative, and intended and unintended -- of use of project innovations. Such feedback may include both the *monitoring of progress* and the *evaluation of impacts.* Both progress monitoring and impact evaluation are intended to help provide information on which to base project improvements as well as reallocation of resources for projects.

Monitoring progress, i.e., tracking or measuring the extent of achievement of project objectives, generally involves less data analysis and provides less project guidance than does impact evaluation. Monitoring tracks extent of *progress* toward achieving objectives for outputs and outcomes (Hatry 1999, 15); it thus can suggest project and program facets requiring management attention. However, *progress measurement* lacks evidence that identified outcomes were caused or *influenced* by project outputs (Perrin 1998, 374; General Accounting Office 1998). Thus, progress monitoring[35] can point only to observed *outcomes* that are *associated* with a project's outputs (Bernstein 1999, 89).

Evaluation of project impact goes beyond such measurement: i.e., it estimates a project's *contributions* to observed outcomes, taking into account *other* influences or contributions (e.g., Hatry 1999, 21-22; Nowak et al. 1997). Impact evaluation is more *explanatory* than is progress monitoring: it accounts for specific influences of projects, including how and why observed outcomes occurred (Perrin 1998; Rosi et al. 1998).

An *evaluation* is capable of demonstrating that a project's outputs influenced identified

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[35] An alternative term "performance measurement" is misleading because it implies that simply measuring extent of attainment of project objectives measures program/project performance, i.e., measures effectiveness of the program/project. The *genuine* measurement of program performance is tantamount to measuring program impacts.

outcomes. When influence of a project's outputs on identified outcomes is actually *demonstrated*--through the use of a variety of approaches and techniques--the outcomes described may be called a project's *impacts* (General Accounting Office 1998). Thus, if other factors--e.g., timeliness of receiving reports--are equal, then impact evaluation generally is more useful than progress monitoring when providing information to help restructure projects in order to improve their effectiveness and justify their budgets.

Progress monitoring and impact evaluations each may include *quantitative* measurements or indicators (e.g., scales/indexes) as well as *qualitative* indicators (e.g., narrative examples/descriptions). Qualitative and quantitative approaches to conducting *impact evaluations*, relative to the HM, include "generative mechanisms," "causal packages," and "rival hypotheses" (Rogers 2001). Besides the use of comparison groups, estimates of impacts also may be based upon statistical modeling techniques--in cases where it is impracticable to obtain direct measurements of impacts, as in short-term evaluations of impact on environmental conditions (Meals et al. 1996).

First-Order Impacts

Types of outputs, outcomes and impacts relative to a collaborative project's *research function* and its *extension function* are identified below. The following division of impacts into first-order, second-order, and third-order impacts is similar to the categorization made in a health research and utilization model by Stryer et al. (2000).

Outputs of a project's *research* function include its "Processes" and "Involvements." These outputs produce *first-order research impacts*, (i.e., research outcomes relative to the project and to science that clearly are attributable to the project rather than to other research efforts).[36]

First-order impacts of a project's *research* function include: (a) modified "Interests" of stakeholders, i.e., toward *continued* or i*ncreased* cooperator participation in the project's research activities and in the type of research activities represented by the project; (b) strengthened "Capacities" of project staff and of the community of researchers--i.e., acquisition of new knowledge, shifts in attitudes, improved skills, and heightened aspirations ("KASAs") gained through the conduct of the research; (c) KASA-based "Innovations," e.g., improvements in the body of recommendations for technologies and practices for audience consideration and adoption; and (d) *ex ante estimates* of potential net improvements in identified "Conditions" expected through widespread use of "Innovations" generated and tested by the project (Figure 7).

Figure 7 [attached]

As mentioned previously (see Figure 4), project *extensionists* (defined in footnote two) may develop, test and/or refine applicable knowledge, practices, and technologies on a *site-specific* basis. Any such work by extensionists contributes to the project's *research function* (Figure 7). Figure 7 applies the HM to research roles of

[36] "Impact" of a specific research project/program is its *particular contribution* to outcomes of a body of research, taking into account *other* contributions to the outcome.

both researchers and extensionists in Stages I and II of the macro-stage model.

Outputs of a project's *extension* function include "Processes" and "Involvements." These may produce *first-order extension impacts*, i.e., extension outcomes that are attributable to the project rather than other communication and demonstration efforts.

Impacts of a project's *extension* function include: (a) modified "Interests"of stakeholders and audience, e.g., toward continued participation in the project's extension activities; (b) strengthened "Capacities" of project audiences -- i.e., expanded knowledge, modified attitudes, improved skills, and heightened aspirations ("KASAs") gained through participating in the project extension activities; (c) audience adoption of project-based "Innovations" that they find to be advantageous and feasible; and (d) extent of actual net improvements in identified "Conditions" that are achieved through use of "Innovations" generated and transferred by the project (Figure 8).

Figure 8 [attached]

As mentioned previously (see Figure 4), project *researchers* (defined in footnote No. two) may *transfer information directly* to audiences to encourage them to consider the use of research-based knowledge, practices and technologies.[37] Any such work by researchers contributes to the project's *extension function* (Figure 8).

Thus, first-order impacts by project *researchers* may include their *direct influence* (performing an extension function) on capacities and actions of project audiences. Figure 8 applies the HM to roles of both extensionists and researchers in Stages III and IV of the macro-stage model.

Second- and Third-Order Impacts

Second-order research impacts of a project may be the incorporation of its first-order research impacts into inputs and outputs of the extension function (see Hargreaves and McDonald 2001; and McLaughlin and Jordan 1999). First-order research impacts that may be incorporated into extension function implementation include:
(a) estimates of the potential for improved "Conditions," that can be realized by (b) plans/targets for clientele use of project "Innovations" through (c) targets for strengthened clientele "Capacities" to use the innovations.

Inclusion of a project's research impacts into its extension function *should occur* to the extent that the research impacts strengthen: (a) extension staff "Capacities" to promote (b) "Innovations" for audience adoption that (c) are likely to help achieve the project's overall ultimate objective (i.e., identified improvements in "Conditions").[38]

[37] Compared with extension information transfer activities, information transfer activities conducted *directly* by researchers are more likely to (a) have a narrower scope of subject-matter content, (b) have less continuity, and (c) focus on audiences who are especially receptive to trying out and adopting new technologies (Bennett 1990, 49-50).

[38] To be included into the extension function of a collaborative project, or into a broader-scope extension program, the demonstrated net advantages of using the research-based *"Capacities,"* and "Innovations" should be consistent with *the specific, current needs and*

To the extent that a project's research impacts are incorporated into the project's extension function, the project's research function is in a position to realize *third-order impacts* through extension.

Third-order impacts of a project's research function are a part of the first-order impacts of the project's extension function.[39] (Again, first-order impacts of a project's extension function include: (a) audience "Interests" in continued or increased participation in the project's extension activities and similar activities; (b) modification of clienteles' "Capacities" relative to (c) *clientele adoption of project-promoted "Innovations"*; and (d) resulting changes in identified soci-cultual, personal, economic, environmental and/or other "Conditions").

Approaches to Attribution

The HM tends to direct thinking toward a simple, linear series of project and project-effected steps toward a desired condition, even though it is fully recognized that progress toward a given condition generally is the result of many factors in addition to those of a project. This complexity was discussed above regarding *contextual factors* in project development and evaluation. Some contextual factors may be *enabling* factors (augmenting the effectiveness of the project); and others may be *restraining* factors (inhibiting its effectiveness).

If a project's contribution to an outcome is to be identified (i.e., identification of a project's *impact*), then it is important to somehow take into account other factors that influence an outcome. The more the influence of other factors can be gauged, the more that uncertainty can be reduced about the particular contribution(s) of a project.

There are numerous approaches to obtaining evidence of a project's contribution(s), i.e., *attributing to it* influence on an outcome. Greater amounts of resources generally are necessary to employ the approaches that most effectively reduce uncertainty about a project's contribution to identified outcomes. Two major approaches to identifying attribution, relative to the HM follow.

Program Theory Matrix

Program theory includes identifying factors that affect attainment of a given condition, and sorting these factors into those that can be influenced by the project (project factors affecting success) and those factors that are beyond the influence of the project but probably have a bearing on its effectiveness (non-project factors affecting success). With the HM, a program theory can be placed into a *matrix*. That is, the titles of the levels of the HM are placed in the left column; the project factors--by level of the HM--are placed in the middle column; and the contextual factors--by level of the HM--

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interests of intended audiences and the relevant public. Users' voluntary adoption of the research-based practice/technology recommendations *depends upon such current consistency* as well as consistency with (d) the project audience's *current level of resources, or opportunities to obtain resources*, to support practice and technology adoption.

[39] Second-order impacts of a project's research function also may be based upon incorporation of its first-order research impacts into *broadly-scoped* extension programs, i.e., those that systemize *across* individual, related projects.

are placed in the right column (Rogers 2001).

Funnell (2000) explains two ways in which a program theory matrix can help deal with the question of attribution. The first way is to help formulate the *design* of an impact evaluation:

> Performance information relating to causality can be drawn from a range of evaluation designs.... All designs typically depend on there being some identification of the program factors (in classic terms the independent variables) and non-program factors (confounding variables) that are likely to affect the outcomes (dependent variables).

A second way that a program theory matrix can be helpful is in *negotiating* a project's accountability and in *improving* its performance, even without using the matrix to formulate an impact evaluation. Simply understanding and articulating the complexity of an overall situation and a project's role within it can assist externally or internally in constructing a more *credible* performance story (Funnell 2000; Mayne 2000).

Designs for Attribution

Simply comparing targeted outcomes with actual outcomes provides little or no evidence of project contribution toward achieving targeted outcomes. There may be explanations for observed outcomes other than a project's outputs. In order to demonstrate that particular outcomes are attributable to a project, alternate (rival) explanations of these outcomes must be taken into account.

Rival explanations may include major trends in society, other programs, chance events, maturation or special motivation of project participants, and effects on project participants that result from collecting evaluative data from then. *Evaluation designs* may be employed to take into account, or partly account for, rival explanations.

Evaluation designs may be viewed in relation to program objectives, and they suggest types and sources of data to be collected as well as approaches to data analysis. Designs vary in their ability to account for alternate explanations.

Accounting for alternate explanations of outcomes is much more problematic for the extension function than it is for the research function. Although competing research projects may sometimes make attribution of first-order research outcomes problematic, the question of attribution to extension project influence is large by comparison. Several designs for examining effectiveness of extension projects are briefly described in Appendix II.

Utilization of Evaluation

Project evaluations may be utilized by project staffs themselves; by *managers* of agencies that conduct collaborative projects; by federal, state, and/or private-sector *purchasers* of projects; and by *funding sources* such as legislatures. The aim of project evaluation is not achieved at the completion and distribution of an evaluation report! Evaluation processes and reports lead to the realization of improved projects and improved accountability only as they strengthen the actual evaluations made by project and program managers, purchasers, and funding sources.

Staff members should be informed as to how reports of evaluations of their projects are utilized by project/program management, project purchasers, and public and/or private funding sources. If project staff believe that their completed evaluations are ignored, not acted upon, misused, and/or underutilized, staff morale associated with conducting and reporting evaluations will plummet!

Ensuring the full utilization of project evaluations is a *managerial responsibility*. Thus, program managers should take the following actions regarding evaluations of project performance:

- o *include in their plans-of-work* the necessary time and processes to guide utilization of project evaluations that have been completed;

- o *empower their staffs* to make evaluation-based improvements in project performance and accountability at their respective levels, as well as to make recommendations for management decisions.

- o *plan for specific ways to utilize evaluations*--e.g., identify needed reporting to multiple stakeholders and reviews of evaluation reports as part of an annual project or program development processes; and

- o *rate extent of improvement* in planning and *performance of projects,* and in their *accountability,* based on utilization of project evaluations.

Managers may need to receive training in order for them to fully utilize project evaluations. Training would address evaluation utilization to improve: (a) project performance as well as accountability and marketing, and (b) policies of middle and top management (both program policies and evaluation policies).

Evaluations of projects are valuable to the extent that they are *utilized* in making project improvements and improving accountability to resource providers. Once again, the seven-level HM may be adapted--this time to help in evaluating and in re-planning project *evaluations.*

The HM may be employed to evaluate a project's evaluation and its utilization. An excerpt adapted from Patton (1986, 171-173), suggests how the seven levels in the hierarchy may be so employed for project/program improvement:

> (1) Resources--resources are devoted to conducting the evaluation, including stakeholders' time and inputs;
>
> (2) Processes--evaluative questions are focused, the evaluation is designed, and data are collected and analyzed;
>
> (3) Involvements--key stakeholders including intended evaluation users participate throughout the evaluation process;
>
> (4) Interests--stakeholders react to their involvement (we hope in positive ways);
>
> (5) Capacities--the evaluation provides new knowledge about, and a basis for modified attitudes concerning, the program's effectiveness--leading to--;
>
> (6) Innovations--i.e., adoption of evaluation-generated recommendations --intended to improve--;
>
> (7) Conditions--i.e., program focus as well as efficiency and/or effectiveness of the program.

The purpose of utilization-focused evaluation is to *increase the quality of decisions* so as to improve program performance and accountability. Addressing the seven steps in the chain above can help rate the effectiveness of a project's evaluation in terms of the extent of its utilization in programmatic, administrative, and legislative decision making.

Proposals and Plans-of-Work

Planning collaborative projects generally requires the use of explicit *planning processes* for project proposals or plans-of-work. Such processes, and adequate resources to employ them, are needed in order to ensure a consensus on a plan at the *general level* across all functions of the project.

Planning a collaborative project typically will include identification of:

- *scope* of the project and the *priority roles* of research and of extension (e.g., in terms of *which* of the four stages of the macro-stage model the project will encompass, and *which* roles identified in this model will be performed by researchers and which by extensionists);

- *linkages* of objectives for the research and the extension functions, types of *evidence* used to evaluate project performance, and *resources* to specify project plans as well as to implement and evaluate their achievement (e.g., all in terms of the hierarchal model (Appendix III).

[See Appendix III]

Initiation of Collaborative Planning

The greatest challenges confronting genuine collaboration are planning across institutional and cultural constraints, knowledge constraints, and financial constraints (Campbell 1992; Chamala and Keith 1995, 12). Following are several *dilemmas* that must be addressed in order to collaboratively plan projects (adapted from Chamala et al. 1999, 20-24).

- *Dilemmas in Initiation of Planning.*

  If planning is initiated at the *administrative* level, project staffs may resist involvement because they see it as a command performance; alternatively, if planning is initiated only by research and/or extension *specialists*, multi-functional staff participation in a project may (a) not commence at all, or (b) be divisive and/or short-lived due to lack of authority structure and administrative sanction for staff time expenditures in the emerging project.

- *Dilemmas Regarding Inclusion*.

  If *all* potential cooperators and relevant stakeholders are included in project formulation, planning activities may become too *cumbersome and time-consuming*; however, if individuals or groups with vested interests are not sufficiently involved in the planning, (a) a *systems* approach to project development is unlikely, and (b) resistance may be generated by those not sufficiently included in project formulation.

- o *Dilemmas Regarding Structure.*

  If too little structure (a power vacuum) exists among potential collaborators, they will have difficulty working together using a “win-win” approach--i.e., there will be too much conflict (or insufficient constructive conflict); alternatively, *over-structuring* may inhibit creativity and appropriate influence--e.g., dominant members or subgroups may block inputs from other staff members that are critical to overall project success.

As collaborative projects emerge and become established, they must deal with the above dilemmas through progressive phases of group development (Chamala and Keith 1995; Taylor-Powell et al. 1998).

Drawing upon the latter set of authors, several tasks associated with three phases of planning are summarized below. These are seen as *initial* tasks of collaborative planning for collaborative projects.

Phase I: Explore Common Interests

- o Identify problems and opportunities and share them with others who may face similar problems and opportunities, and hold similar views.

- o Solicit ideas of relevant others, including potential members of the collaborative project team and principal stakeholders.

- o Facilitate potential team members’ exploration of their collective interests, concerns, and resources and discuss whether a project that achieves integration may be possible.

- o Seek a shared definition of the problem to be addressed, if discussants sense a shared vision and readiness to attempt joint activity.

Phase II: Organize to Plan Project

- o If both a shared definition of direction and scope for a project emerge, then explore a potential authority structure and delineation of roles within the emerging team.

- o Propose roles, responsibilities, and accountability standards for individuals and subgroups within the emerging team, as well as decision-making rules and procedures.

- o Obtain ratification by the appropriate administrative staffs of an agreement to support the collaborative team, thus securing staff and other resources for collaborative proposal planning.

Phase III: Plan the Project

- o A collaborative team may wish to plan along the lines indicated in this paper; that is, employ the macro-stage model to help articulate project scope and priorities, and employ the hierarchal model to help set project objectives, project evaluation criteria, etc. (Appendix III).

- o Continue to draw sponsoring administrators as well as other stakeholders into active support for the project’s processes, products, and evaluation approach.

- *o Formulate the project’s evaluation plan.* Inclusion of formal evaluative expertise as part of a collaborative team generally is advisable in order to maximize helpful feedback and evaluation (Appendix I provides supporting examples).

- o Submit proposal for receipt of funding to support the collaborative project.

Interaction processes used to initiate collaborative planning must build the *trust* and *mutual recognition* that are necessary to plan a project that achieves integration.

Collaborative planning builds *a consensus* across the engaged research, extension, and between them and multiple stakeholders. Collaborative processes may be facilitated by relying on participatory workshops for planning and evaluating projects.

<u>Resources for Collaboration</u>

As asserted above, team members (perhaps with the help of project stakeholders including administrative staffs) *jointly propose* project objectives and types of evidence of project accomplishments. Such planning should *simultaneously* select a general set of objectives and evaluative criteria for research and for extension.

Although such multi-functional interactions can bear rewarding payoffs, they tend to *complicate* project planning and evaluation processes. This means that proposal or plan-of-work preparation for a *collaborative* project tends to require *a greater time commitment* than such preparation for a project *within* research, *within* teaching, *or within* extension, other factors being equal.

Hence, planning for collaborative projects is likely to be more costly than coordinative or cooperative planning (Hagel and Singer 1999; Toulemonde et al. 1998). *Robust resources are needed to support preparation of genuinely collaborative proposals.*

In the event that a general, collaborative approach to a proposed project is approved for funding, ear-marked resources are likely to be needed to support *continued* collaborative mechanisms, e.g., in order to *specify* linkages among initially-selected objectives for research and for extension functions.

Given simultaneous planning of objectives for research and extension, normally there will be a "time lag" between research plan implementation and full implementation of the linked extension plan. Such lag time may be fruitfully utilized to *specifically plan* for (a) extension site specific testing and refinement of technologies and practices, as well as (b) extension conveyance of information and education to project audiences (including making baseline measurements and segmenting intended audiences).

Finally, there will be need for joint *evaluative* planning, including posing questions to be addressed through collecting data on project effectiveness. Evaluative planning, too, generally will require additional staff time--*above and beyond* the staff time needed for planning projects *within* research or *within* extension.

Conclusions and Implications

Higher rates of return are being sought from all public-sector agencies. Along with them, public-sector research and extension must find ways to continually improve their respective and combined performances. Public-sector programs/projects in research and in extension address the *development,* *refinement,* and *application* of capacities and innovations; they are accountable for demonstrated effectiveness in solving individual, group, and societal problems.

One major way in which public sector research and extension may improve their respective performances is by *strengthening their connections.* Such strengthened connections can increase benefits to *users* of research-based capacities and innovations as well as the general *public*.

There appears to be a trend toward allocating an increasing proportion of funding for extension work to projects that integrate the work of extensionists with that of researchers. Those individuals and groups that conduct and oversee such integrative projects are challenged to plan, implement, and evaluate *collaboratively.*

There is needed for use of integrative theoretical models to assist in collaborative planning and evaluation. Used sequentially, the two models advanced herein can help collaborative projects first *select roles* that bridge their research functions and extension functions--and then *plan and evaluate* the particular roles selected.

Full collaboration requires more than relying upon effective communication about the project, joint appointments of individuals across research and extension functions, and formations of teams in order to bridge across extension and research functions. Beyond reliance on the three foregoing, important factors it also is necessary to *effectively formalize* the planning and evaluation of collaborative projects by using *integrative theoretical models.*

The macro-stage model and micro-step model presented herein generally should be helpful as used sequentially in:

- o electing and linking the roles of project extension functions and research functions relative to the roles of users in the overall process of generation, diffusion and utilization of capacities and innovations; and

- o guiding the planning and evaluation of the selected roles, as well as reporting on their degree of effectiveness -- through facilitating the choice and linkage of objectives and evaluative criteria for the selected roles.

Thus, tandem use of these models should *facilitate collaborative research and extension projects*. The principal test of this paper's usefulness is threefold, i.e., how well it helps researchers and extensionists *strengthen*: (a) effectiveness of their collaborative projects; (b) evaluations of the effectiveness of these projects, and (c) utilization of such evaluations.

General Recommendations

Based upon the preceding discussion, three general recommendations follow.

- o *Research-extension teams should consider employing the macro-stage model to help select the roles to be performed within their projects as well as the priority of the roles.*

  The macro-stage model can help to identify *all* the needed roles of research and of extension, rather than simply a portion of them. The model can *guide staff dialog* toward selecting the needed roles and their rank-order of priority.

- *Research-extension teams should consider employing the micro-step hierarchal model to help plan and evaluate the particular roles, or cluster of roles, that they select for their projects*.

  The hierarchal model can help to develop at the *outse*t of a collaborative project the objectives and the evaluation criteria for both for its research roles and its extension roles.

- *Extension staffs should systemize across collaborative projects that are related to each other.*

  Such systemization is needed to develop extension programs that address audience needs that are broader than those addressed by individual collaborative projects. Any local, state, and national extension efforts based only upon unconnected, or marginally connected, research-extension projects are likely to be fragmented and therefore ineffective and unsustainable.

<u>Agency-related and Other Uses</u>

Heeding the recommendations of this paper should help staffs and administrators of several *agencies and organizations* to better relate to each other; to agricultural producers and natural resource users; and to processors, marketers, and consumers.

- The relevant federal research and/or extension agencies in Australia and in the U.S. should be better able to conceptualize and strengthen their programs as well as improve their accountability to policy makers, funding sources, and other national stakeholders.

  The intended advantages to federal agencies include those for:

  - The Commonwealth Scientific and Industrial Research Organization (CSIRO)--in formulating, implementing, and evaluating effectiveness of its strategic plans, sectoral programs, and linkages with partners and other stakeholders;

  - The Cooperative State Research, Education, and Extension Service (CSREES)--in formulating, implementing, and evaluating the effectiveness of its strategic plans, unit programs, and linkages with partners and other stakeholders.

  - CSREES--in developing (a) requests for project applications (RFAs) and (b) guidelines for submission of plans-of-work and accomplishment reports. Use of the recommendations should *encourage* collaborative research-extension efforts. Appendix III distills this paper's major themes as *pointers* for "Requests and Guidelines .... ," and reinforces guidelines to receive project funding based on "outcome proposals" (e.g., Northeast Region Sustainable Agriculture Research and Education, 2000).

- State *agencies and universities* in Australia that are responsible for research and extension should be better able to construct *collaborative projects*--in order to speed rates of development, refinement, and application of new and improved knowledge, technologies and practices (Appendix III).

- o Staffs of research and of extension units within *universities* across the U.S. should be better able to construct *collaborative projects*--in order to speed the rate of development, refinement, and application of new and improved knowledge, technologies and practices (Appendix III).

- o Manufacturing firms, commodity associations, and other *private-sector groups* should be better able to *partner* with public-sector agencies and universities, through gaining understanding of their research and extension processes as well as *how to* collaborate with them.

This paper should assist the *public and private-sectors* in Australia and the U.S. in the several ways. These include the following:

- o Governmental and private-sector sources that *fund and/or purchase* collaborative projects should be better able to assure that proposed project plans are appropriate and workable (Appendix III also can apply here).

- o Public sector research and extension agencies should be better able to:

  - C *articulat*e--and receive mutual support for--their respective functions;

  - C *agree* on--scope and priorities of collaborative projects; appropriate output and impact *objectives* and associated evaluative *indicators*; and warranted evaluative *conclusions*.

- o Agencies sponsoring collaborative projects should be able to improve their *accountability* to policy makers, funding sources, and other stakeholders.

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Table 1.

How Three Types of Models Characterize Extension Programming

Major Characteristics and Roles of Extension	Research-Transfer	Learning Systems	Inter-dependence
Bases its programs on:			
C A variety of assessments of needs and resources;		X	X
C Relevant research agency/industry outputs;	X	X	X
C Relevant non-research information.		X	X
Conducts applied research as necessary and feasible.	X		X
Transfers information and recommendations regarding specific practices and technologies.	X	X	X
Influences research agencies and industry.	X		X
Educates users of technologies and practices as well as other clientele.		X	X

Table 2

Hierarchal Model Reporting on Linked Research and Extension Performance

Level	Research Function Performance ú	Extension Function Performance
Conditions	Vision of soci-cultural, economic, environmental and/or other conditions *expected* from potentially widespread use of practices and technologies developed or improved by the project.	Indication of the social, economic, environmental and/or other conditions, or *improvements* in conditions, that *resulted from* project-influenced uses of the new or improved practices/technologies.
Innovations	Description of the *new* or *improved* practices and technologies (for achieving better conditions), based on new KASAs that staff learned through the project.	Indication of *extent of use* of the new/ improved practices and technologies based on KASAs learned by clientele (users) through their involvements in the project.
Capacities	Description of the *project staff's* new: knowledge (*K*), attitudes (*A*), skills (*S*), and aspirations (*A*)--*learned* through conduct, interpretation, and synthesis of research findings.	Indication of new awareness as well as learning of knowledge (*K*), attitudes (*A*), skills (*S*), and aspirations (*A*) by *users* and *other stakeholders* through their% project involvements.
Interests	Indication of *stakeholders'* (e.g., cooperators') ratings of project leadership, processes, and content.	Indication of *stakeholders'* (e.g., cooperators' and participants') ratings of project leaders, processes, and content.
Involvements	Descriptions of types and numbers of project *stakeholders* (e.g., cooperators) as well as attributes of their project participation.	Description of types and numbers of project *stakeholders* (e.g., cooperators and audiences) as well as attributes of their project participation.
Processes	Description of the approach and methodologies used to *generate* and *test* improved knowledge, and to use it in developing the new or improved technologies and practices envisioned. .	Description of the approach and methodologies used to *test*, on-site, and *deliver* the new or improved practices and technologies, as well as provide related *education*.
Resources	Description of staff who *conduct research* including their qualifications; volunteer roles; equipment; services utilized; and operating budget.	Description of staff who *conduct extension* including their qualifications; volunteer roles; equipment; services utilized; and operating budget.

Table 3

Hierarchal Model Use to
Plan and Evaluate a Research-Extension Program:
Legume Crediting to Determine Rates of Application of
Commercial Nitrogen (N) Fertilizer to Crops

Objectives for Research and Extension

Conditions:	*Reduce* risk of water pollution from excessive applications of *N* fertilizer, and simultaneously *reduce* producers' costs of commercial *N* fertilizer as well as time and stress in applying it (objectives set through: networking with the public as well as relevant interest associations and advisory groups; use of socio-economic data; and use of past agronomic and hydrological research).
Innovations:	*Develop through research* and *publish* validated practice recommendations for how, and under what conditions, to *grant legume credits* when determining rates of application of commercial *N* fertilizer; and, through extension, *accelerate producers' adoption* of the recommendations for legume crediting practice. The practice translates tons of legume/acre produced just prior to non-leguminous crop production into (a) *a corresponding decrease*, compared with conventional practices, *in lbs. of N fertilizer needed to achieve crop yield targets*, and (b) cost-of-production dollars saved through decrease in application of commercial *N* fertilizer. *Accelerate adoption* of the recommended legume-crediting practices through *extension* processes in concert with other public-sector agencies and private-sector organizations.
Capacities:	*Learn through research*, and *through extension help producers learn* as applicable: lbs. per acre of *N* fixed per ton of legume produced across agronomic variables (*K*nowledge); procedures to measure, *practically and simply*, tons/acre of legume produced (*A*ttitudes); procedures to measure, *reliably and validly*, tons/acre of legume produced (*S*kills); and production cost savings *achievable* through legume crediting to lower rates of commercial fertilizer application (*A*spirations).
Interests:	*Identify* the types of producers who are potential *research and test-demonstration cooperators*--i.e., those with motivation and abilities to adequately and positively perform roles in innovation development and assessment through participation in test-demonstrations.

(Table 3 Continued)

	Identify characteristics of producers who are likely to be: (a) early adopters, i.e., influenced by the test-demonstrations and ensuing *extension* information transfer and education, and (b) influential to their neighbors in supporting adoption of legume crediting.
Involvement:	*Select* appropriate types and numbers of *producer-cooperators for research* processes, and *identify extension crop producer and consultant audiences*. Select producer audiences that sufficiently *represent* the socio-economic distribution of producers in the targeted watershed and are sufficiently *large* in total farming acreage to enable the conduct of efficient and effective extension activities that potentially can reduce degradation of water quality in targeted watershed(s).
Processes:	*Target* laboratory and field *research* sites located across relevant soci-economic and agronomic variables; e.g., legume stand densities, rates of and procedures for soil inoculation, etc. *Plan* for site-specific test demonstrations in order to market and teach relevant capacities (KASAs). *Select extension* methodologies to build, where needed by producers: problem perception, awareness of and familiarity with the new or improved practices; positive evaluation of and skill in using the improved practices; and willingness to try out these practices.
Resources:	*Justify and budget* resources for staff expertise and time to conduct the project's *research and extension activities* including dissemination of recommendations plus audience discussions of field-demonstrations. Allocate budget to cover costs of equipment, communications, and transportation as well as costs of *project monitoring and impact evaluation.*
	Desired *Evidence* on Research and Extension Performance
Resources:	Has there been allocation of budgeted resources to conduct the planned *research and extension processes* and obtain the expected types and amounts of participation? Did the expected caliber of research staff *efficiently expend* the time and dollars budgeted to develop, test, and publish information about the improved practices and technologies envisioned? Has the expected caliber of extension staff *efficiently expended* the time and dollars budgeted to disseminate the improved recommendations and demonstrate their use within targeted localities?

(Table 3 Continued)

Processes:	Were targeted laboratory experiments, field *researches*, and demonstrations *conducted to the extent planned*? Were analyses of the data competently conducted and interpreted? Were *extension* plans *implemented appropriately*; e.g., have the new or improved technologies and practices been marketed to audiences appropriately? Has existing and new subject-matter content been transferred to audiences effectively? Has educational methodology been implemented effectively, e.g., has information been transferred through clientele-preferred communication channels?
Involvements:	Did a sufficient proportion of the selected cooperators and consultants become *involved*--with sufficient duration and intensity--in the *research processes*? That is, did a sufficient proportion participate adequately in the development, testing, and systemization of recommended practices? Has the acreage of the audience of producers *involved* in *extension* activities become high enough to allow the widespread practice changes required to significantly improve water quality in the targeted watershed(s).
Interests:	Did a sufficiently high proportion of producer-cooperators in *research* and test-demonstrations *endorse* the project's research personnel, processes, and outputs? Have a sufficiently high proportion of *the extension audiences* and other stakeholders *endorsed* the project's extension personnel, processes, and outputs?
Capacities:	Did project staff learn the following through their *research*: -- (K) *amount of N* fixed per ton of legume/acre produced under varied conditions? (A)-- procedures for measuring tons/acre of legume production in a *simple/practical* manner? -- (S) procedures for measuring tons/acre of legume produced in *reliable/valid* way? and (A) production-cost *savings achievable* through legume crediting that lowers rates of commercial fertilizer application? Are there *evaluative findings* on extent of diffusion of the new capacities among *extension audiences* in the project area? Are findings regarding degree of KASA change *keyed* to user characteristics? Do findings regarding extension audiences' knowledge and attitudes exist on the following points? (a) their perception of extent to which *N* fertilizer conventionally is overly-applied; (b) their *comprehension* of nitrogen fixation processes and self-directed application of knowledge

(Table 3 Continued)

	about these processes; (c) their *awareness and familiarity* of research-based legume crediting practices; and their *evaluation* of these recommended practices?
Innovations:	Has there been *publication* of the project's *research-based procedure* for determining application rates of commercial *N* fertilizer when using legume crediting? Has there been a translation, from tons of legume/acre produced in to: (a) lbs. per acre of commercial fertilizer substituted for by every additional ton of legume produced/acre; and (b) cost of production dollars saved through this substitution, compared with cost of use of conventional practices, in terms of total reduction of lbs. of *N* fertilizer needed to achieve crop yield targets? Are *evaluative findings* available regarding extent of adoption of the recommended legume crediting practices by *extension audiences* in the project areas? Do these findings chart how rates of adoption vary by users' characteristics? Do findings exist on whether the research/extension project is helping to *accelerate* the adoption of granting legume credits?
Conditions:	Have *calculations or estimates* (for the project area) been made regarding the *projected extent of improvement* in the following types of economic, environmental, and socio-cultural conditions, based on projected extent of adoption of the recommended legume crediting practices (e.g., on 40, 60, or 80 percent of the production acres/hectares): (a) how many fertilizer purchase *dollars* would producers collectively and individually save? (b) how many tons of commercial fertilizer would potentially be *prevented* from entering the non-crop watershed environment? and(c) how much application *time* and *stress* would producers individually and collectively be expected to save? Do evaluative data and calculations, or estimates, exist on the extent to which the projected economic, environmental, and socio-cultural, outcomes (associated with usage of the improved practices) *actually were achieved* in the project area? Do these calculations or estimates include analysis by types of producers in the project area

Table 4

Hierarchal Model Use to Plan and Evaluate a Research-Extension Program: *Development and Promotion of a Gene Marker for Meat Marbling in Beef Cattle*

Objectives for Research and Extension

Conditions:	*Increase* marbling performance by feedlot cattle; *speed* genetically-based weight gains compared with conventional breeding and feeding; *increase* export and consumer acceptance of meat from beef cattle; and *reduce* environmental demands by increasing feeding efficiency (objectives set through: networking with the public as well as with relevant interest and industry associations and advisory groups; use of socio-economic data; and use of past research on genetics, animal production, and marketing).
Innovations:	*Develop through research* and *publish* (a) gene (DNA) marker technology to detect marbling propensities; (b) practices for using the DNA marker to select breeding cattle, and (c) practices for using the marker to screen non-pedigreed animals for feedlot entry. *Accelerate adoption* of the gene marker technology and practices through *extension* processes in concert with other public-sector agencies and private-sector organizations.
Capacities:	*Learn through research*, and *through extension help producers to learn about*: a gene marker for marbling propensity (*K*nowledge); procedures to *rapidly and easily* integrate commercially available gene marker test kits and associated services into breeding and feeding operations (*A*ttitudes); effective use of the kits in breeding and feeding operations (*S*kills); and extent that *higher profits are achievable* through efficient identification of animals with high probability of marbling (*A*spirations).
Interests:	*Identify* characteristics of potential *research cooperators*, i.e.: (a) producers who have demonstrated *innovativeness* in improving beef production and reducing its costs through the application of new technologies; (b) extension advisors motivated and able to help develop and refine practices for improved production systems and to assist in promoting their use; and (c) resourceful commercial firm(s) that seek to manufacture and market improved technologies and/or provide commercial supporting services. *Identify* characteristics of initial *extension producer-audiences* who generally are innovators or early adopters in considering new technologies to improve beef production and decrease its costs.

(Table 4 Continued)

Involvements:	*Identify* and *select* appropriate types, and numbers/proportions of *research cooperators*--i.e., animal producers, extension staffs, and manufacturing firm(s)--to assist in credible development of gene marker system for the beef cattle industry. *Identify* and *select extension audiences* that are both sufficiently representative of beef cattle producers and large enough to enable efficient and effective promotion of the gene marker system for producers' adoption.
Processes:	*Target research* collection of DNA from a range of production systems, genetic backgrounds, and environments. Plan for *identifying* and assessing alternative DNA markers against known phenotypes and estimate the proportion of variance explained by each marker. Plan for *integrating* this information into standard breeding equations. *Plan* tests of efficacy of DNA markers in producer-based trials. *Select* methodologies to foster early investment by firm(s) that wish to commercialize the marker test kits. Plan for *development and assessment* of practices by which to use the DNA marker in selecting animals for lot feeding. Select *extension information and methodologies* to build among beef producer audiences: perception of problems due to inefficient marbling; awareness of and familiarity with the gene marker test kit and with techniques for using it; a positive evaluation of the marker system; and a willingness to try out the DNA test kit and associated practices.
Resources:	Estimate, justify, and budget resources required for processes of *research, promotion of commercialization, and extension:* i.e., salaries, equipment, laboratory disposables, information technology, communication, and travel. Base resource needs on costs of processes needed to engage appropriate cooperators who represent producers, extension, and commercial service providers. Allocate budget for *progress monitoring and impact evaluation.*
	Desired *Evidence* on Research and Extension Performance
Resources:	Were budgeted resources *sufficient* to conduct the planned *research and commercialization processes*, and sufficient to obtain the expected types and amount of involvements in these processes? Were the expected caliber of research staff recruited or supported? Did staff *efficiently invest* the budgeted time and dollars to develop, assess, and publish information about the gene marker and associated management practices? Were budgeted resources sufficient, and were they efficiently invested, to a) involve producers-cooperators in field assessments of the gene marker system, and (b) involve *through extension* other producers in learning

(Table 4 Continued)

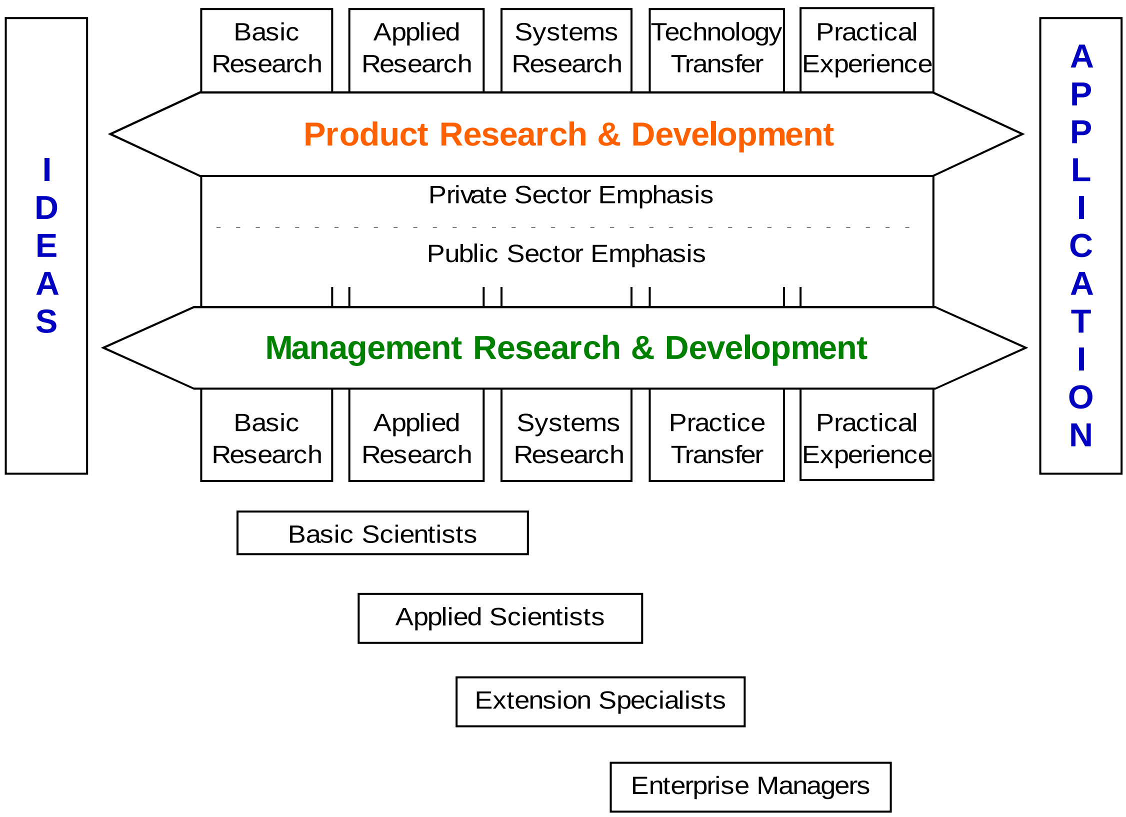
	about, observing, and considering adoption of the gene-marker system in breeding and feeding management?
Processes:	Was the *research* conducted over an *adequate range* of production systems, genetic backgrounds, and environments? Was identification of the *best* DNA marker and follow-up assessment conducted appropriately? Were field trials with cooperators and analyses of data competently conducted and interpreted? Was one or more suitable manufacturing firms identified and recruited, and recruited at an early stage of the program? How could program processes have been more effective/efficient?
	Has there been appropriate implementation of *extension* plans for transferring key types of marker information to beef cattle producers, including transferring information that points to needs for better breeding and feeding techniques to remain competitive? Has the gene marker system been promoted/marketed appropriately to early adopters, and has the relevant subject-matter content been transferred to them effectively? Have educational methodologies been effectively and efficiently implemented?
Involvements:	Did selected producer-cooperators participate in *research assessment* of the marker system for a sufficient time duration? Were there enough such participants in these assessments? Did the selected manufacturing firm(s) fully participate in the assessment activities?
	Have expected levels of *extension audience involvement* been achieved? Is the proportion of beef producers becoming *involved* in the targeted extension processes sufficiently high to potentially make the widespread practice changes required to improve the economy of the beef sector in a timely manner?
Interests:	Did producer-cooperators *endorse* the gene marker research process during and following their *research* involvement in it? Are a sufficiently high proportion of *extension* agents *endorsing* the process for development of systems for using the marker in breeding and feeding operations? Did the selection of cooperators and the assessment procedures contribute to the *credibility* of the technology and *acceptability* of its application by producers?
	Are producer audiences showing positive reactions to and increased *interest* in *extension* events and communications employed to transfer the gene marker system and provide education about gene marking?

(Table 4 Continued)

Capacities:	Did *researchers learn enough* in applying molecular genetics to identify a suitable DNA marker for marbling in beef cattle (*K*nowledge)? Were procedures developed to *easily and practically* integrate the DNA test into breeding and feeding operations (*A*ttitudes)? Were recommended practices adapted and refined to *enable* producers to effectively make marker-assisted selections (*S*kills)? Were methods to calculate farm-level economic benefits developed, so as to foster producers' *incentives to* use the gene marker system (*A*spirations)?
	What is the extent of *extension diffusion of capacity* among beef producers to use the DNA marker system? Are findings available on producers': views regarding needs to adopt improved breeding and feeding methods to remain competitive, as well as awareness of and familiarity with the gene marker test and associated practices (*K*nowledge); evaluation of the gene marker system for their own operations (*A*ttitudes); skill in using the test kit and applying test results in breeding and feeding operations (*S*kill); and plans to try the gene marker in their operation within a year (*A*spirations)?
Innovations:	Was a marker test kit developed through project *research* that meets or exceeds project expectations for effectiveness and efficiency? Was the kit made commercially available, and if so, how widely available is it? Have *practices* by which producers are to use the test kit in breeding and feeding selections been reduced to *easily-followed procedures*?
	How well are the marketed test kits selling, through the efforts of *extension* in conjunction with those of the test kit manufacturing firm(s) and private consultants? How many of the audience producers are using the system and how many tests are being run? For what proportion of the total beef herd is the marker test used? Are there evident patterns of adoption in breeding management and feeding operations?
Conditions:	How much improvement has there been in marbling performance-on-feed, i.e., increase in the percentage of animals achieving an acceptable degree of marbling through use of the test kit system? Are rates of genetically-based weight gain increasing and, if so, to what extent?
	Are consumers increasingly purchasing beef meat produced via adoption of the gene marker system? Are the results of gene marker system use cost-competitive? Are there calculations or estimates of how much economic and environmental conditions would improve through widespread adoption of the gene marker system?

Figure 1.

Research, Development, and Transfer Model

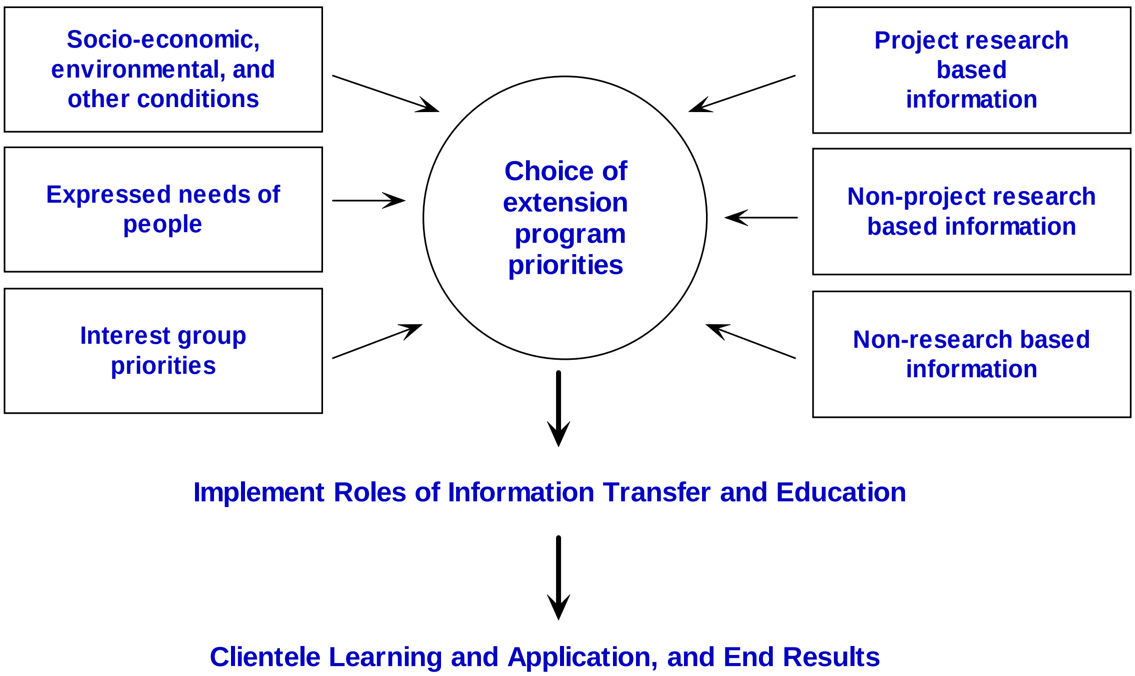


Source:
Planning and Evaluating Collaborative Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Based on original model diagram by D. Holt, 1986.

Figure 2.

Extension Planning within a Learning-System Model

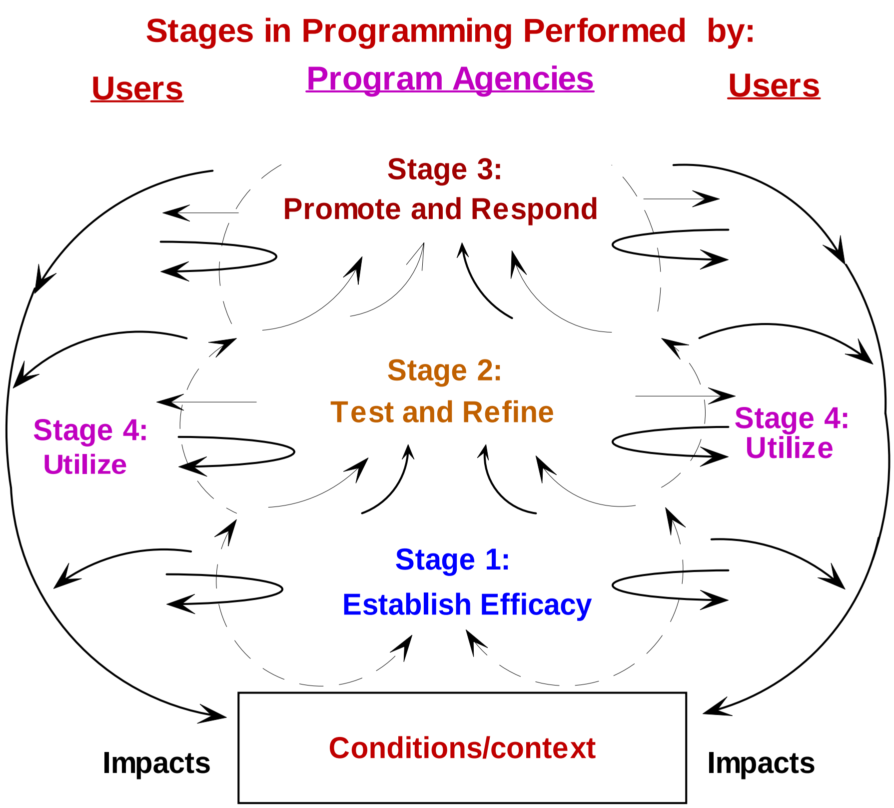


Source:
Planning and Evaluating Collaborative Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Based on original diagram by Ad hoc Committee for Program Development, 1974.

Figure 3.

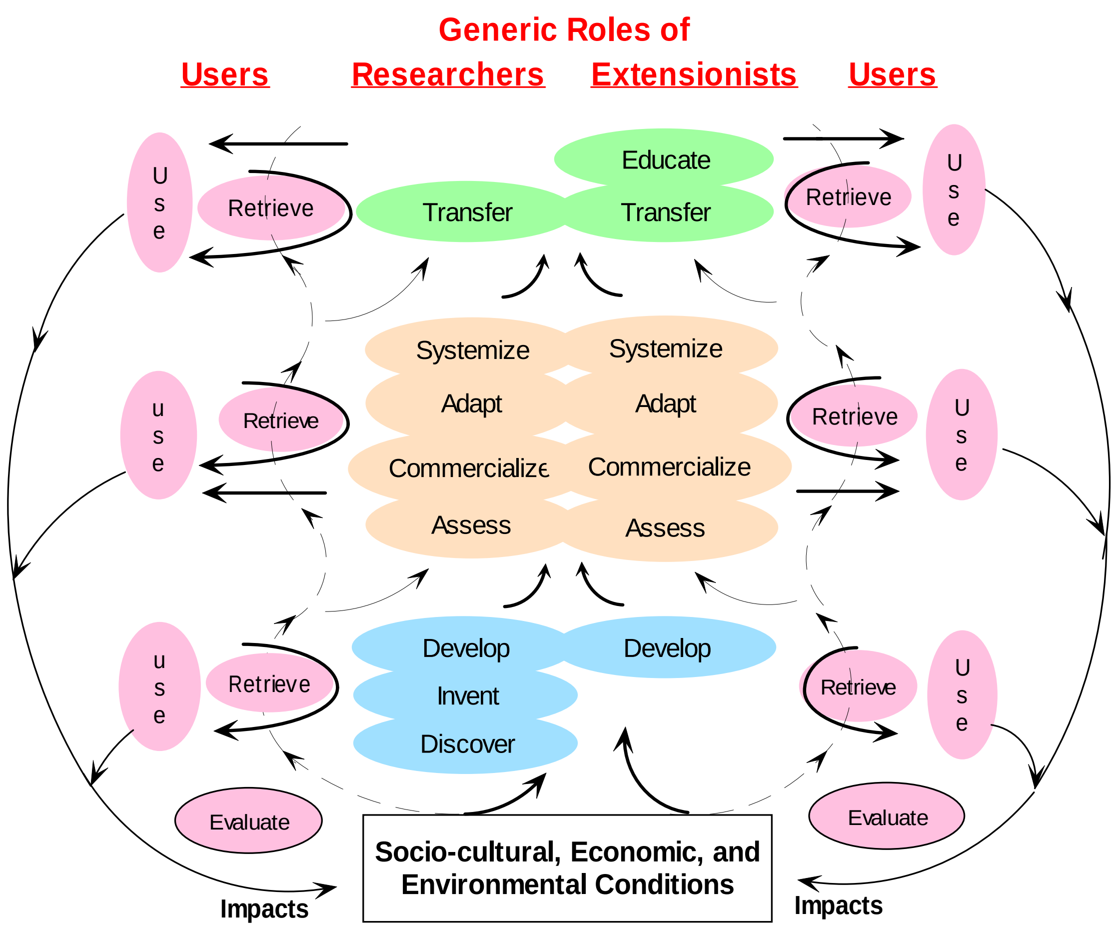
Model of Macro-Stages in Programming



Source:
Planning and Evaluating Collaborative Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Figure 4.

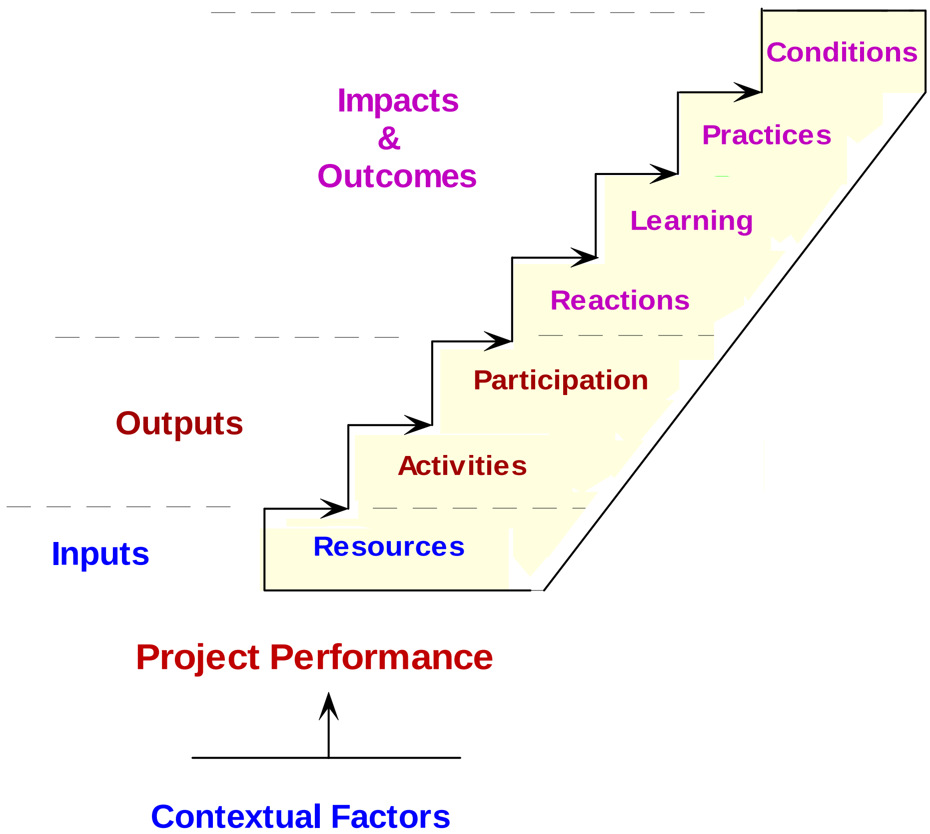
Interdependence Model of Generation, Diffusion, and Utilization of Technologies and Practices



Source:
Planning and Evaluating Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Figure 5.

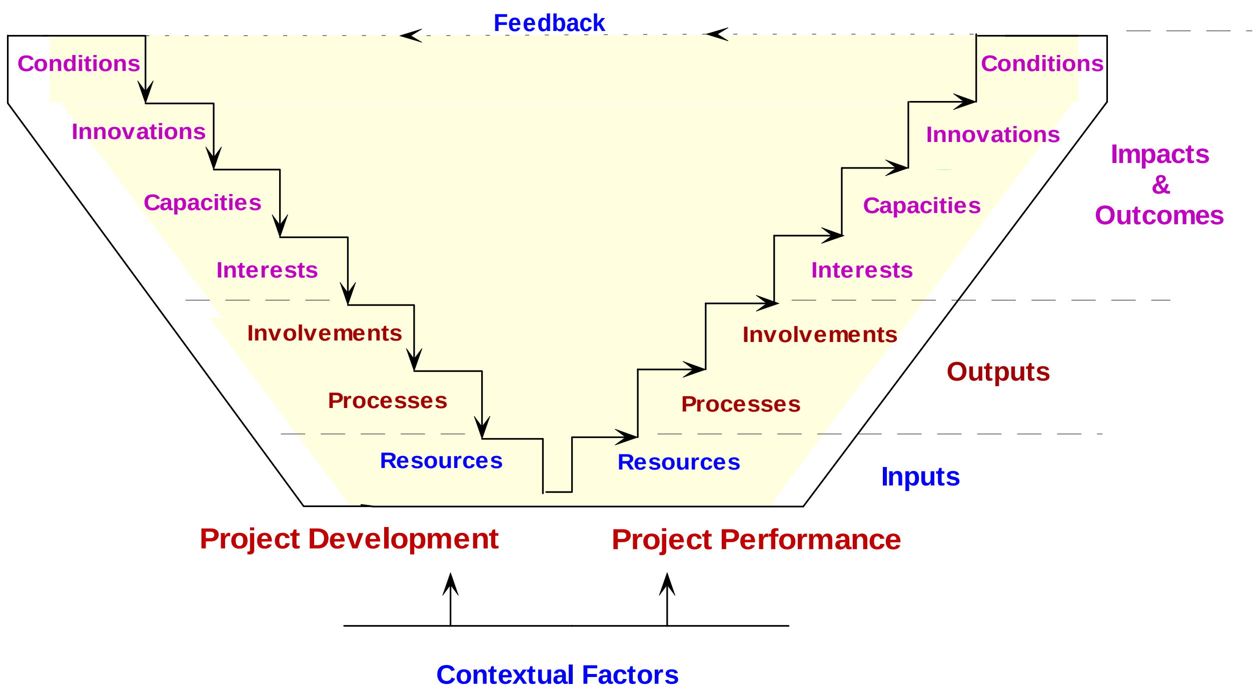
Hierarchal Model for
Evaluation of Extension Programs/Projects



Source:
Planning and Evaluating Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Figure 6.

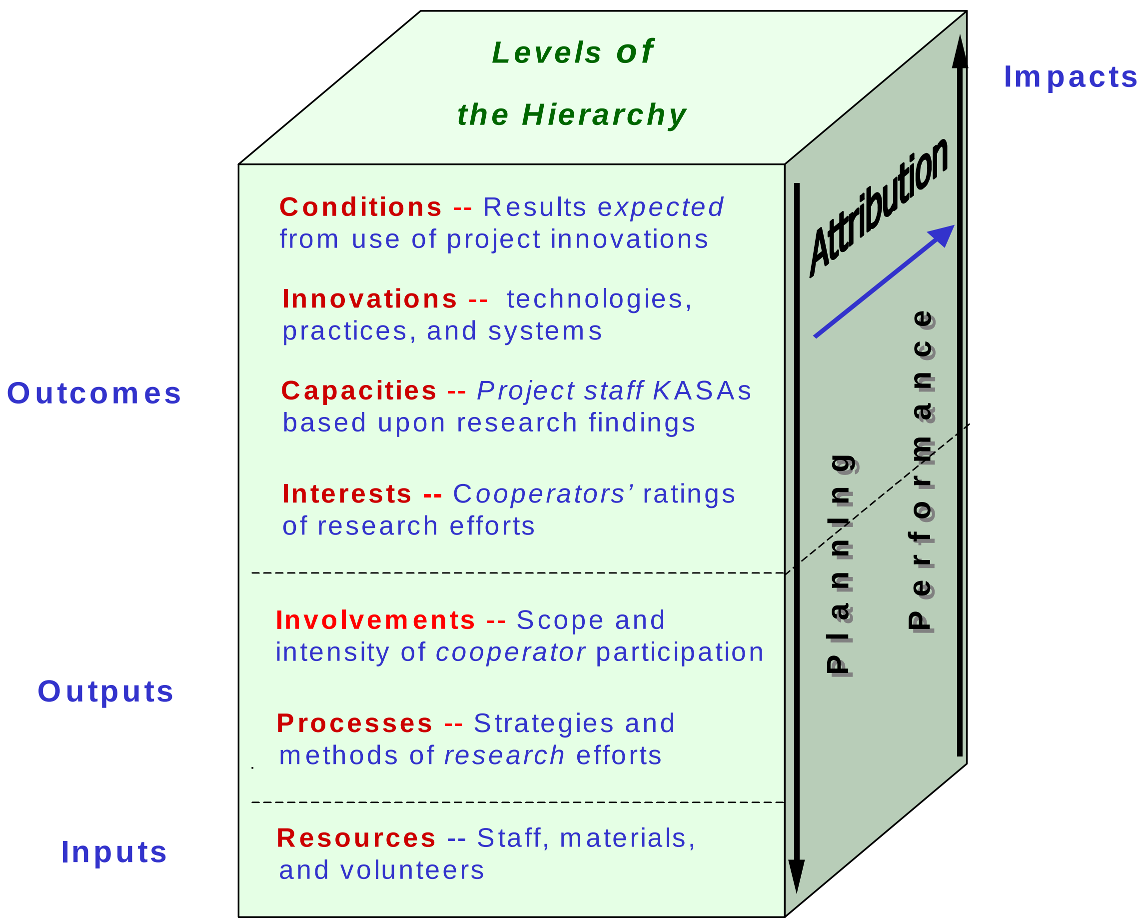
Hierarchal Model for Program/Project Planning and Evaluation



Source:
Collaborative Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and Brian McNeal

Figure 7.

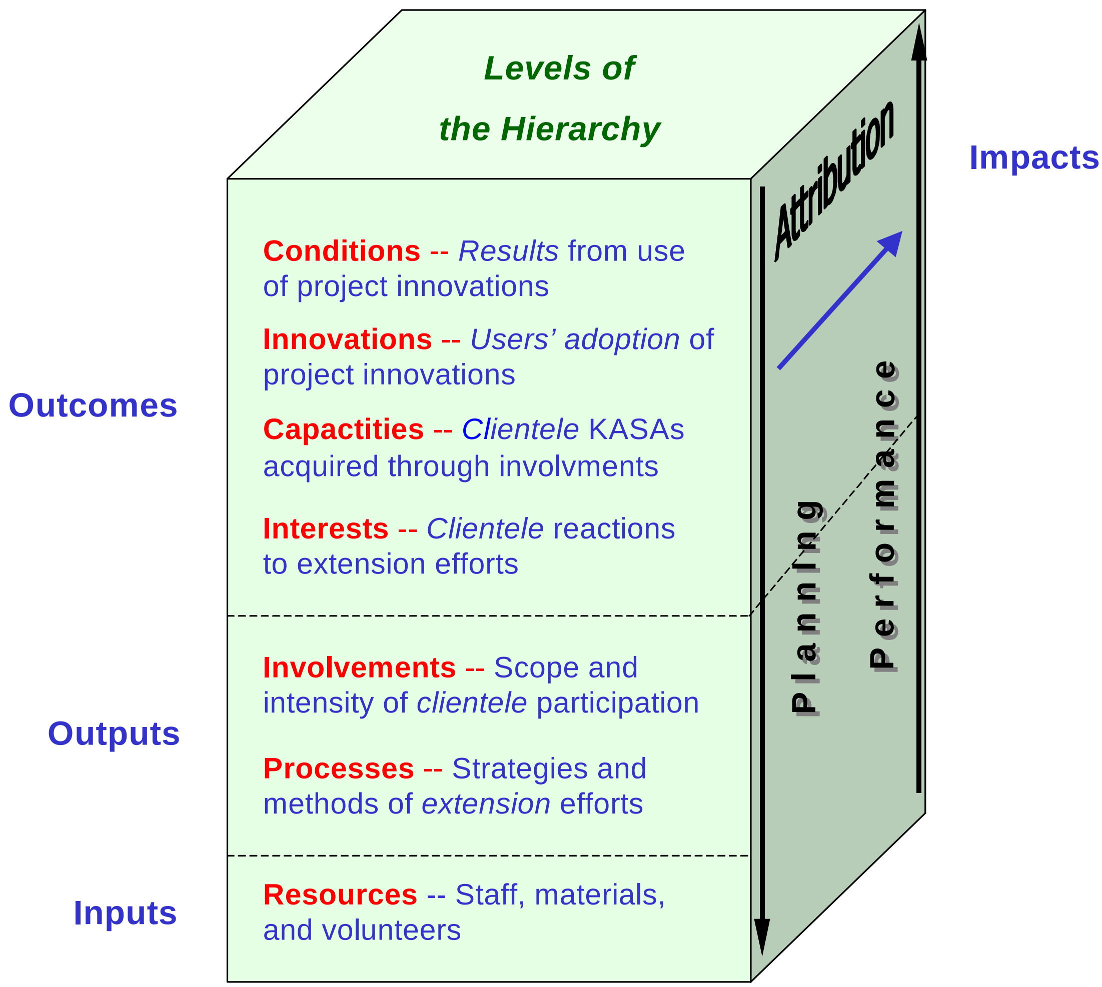
Hierarchal Model Applied to Planning and Evaluation of Research Function



Source:
Planning and Evaluating Collaborative Research and Extension (2001),
by Claude Bennett, Shaun Coffey, Bronwen McDonald, and BrianMcNeal

Figure 8.

Hierarchal Model Applied to Planning and Evaluation of Extension Function



Source:
Planning and Evaluating Collaborative Research and Extension (2001), by Claude Bennett, Shaun Coffey, Bronwen McDonald, and BrianMcNeal

Appendix I:

Reflections on Lake Manatee Demonstration

The Lake Manatee Watershed consists of 81,000 acres in Manatee County, which is situated along central Florida's Gulf Coast. The Lake Manatee Reservoir supplies drinking-water for 275,000 residents of the area.

Over the years, quality of water in the Lake Manatee Reservoir has suffered from periodic algal blooms, necessitating heavy treatments with copper sulfate in order to maintain acceptable aesthetic properties.

The Lake Manatee Demonstration Project was funded by the U.S. Department of Agriculture, in 1990, as part of the multi-departmental Water Quality Initiative of the Presidential Budget. The project was *one of 16 USDA interagency demonstration projects* funded nationally, focusing on various aspects of water contamination from agricultural sources.

Purpose and Scope of the Project

The dual purpose of the Lake Manatee Project was to (a) reduce plant nutrient and pesticide loadings to surface water and groundwater in Manatee County, and (b) develop and test procedures to reduce such loadings on a broader geographic scale.

The University of Florida's Cooperative Extension Service--including staff with joint appointments in *research, extension,* and *teaching*--collaborated with USDA's Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA) to propose and conduct the Lake Manatee project. Cooperative Extension's input to the project, conducted between 1991 and 1996, was partly funded by the Cooperative State Research, Education, and Extension Service, USDA.

Leaders of the project were based in Gainesville, FL (both University of Florida staff and USDA staffs). These staff, as well as the local and regional staffs involved, initially held mental reservations concerning proposed project workloads, work assignments, and rewards for performance of assignments.

However, the project operated surprisingly well. This was, in large part, due to willingness by the Gainesville staffs to spend considerable time-on-site, as well as in travel status between Gainesville and Manatee County (175 miles from the main campus of the University of Florida and the state offices of NRCS), in order to support and conduct project efforts.

Relative to the macro-stage model described above, the Lake Manatee project encompassed Stage II (Test and Refine), Stage III (Promote and Respond), and Stage IV (Use and Evaluate). Regarding Stage II, most of the project's research was site-specific. Such *adaptive research* is recognized as common to both applied researchers and extension specialists.

Project management was effected through meetings held monthly (typical early in the project) and quarterly (typical later in the project). Agenda items for meetings included review of project progress, continuing needs to be met, and planning for subsequent project activities.

Planning and Management of the Project

Though partly fortuitous, collaboration among the multiple agencies and their individual project staff members evolved and was maintained throughout the life of the project. This collaboration occurred because each individual involved had something to give to, and something to gain from, the project's interdisciplinary, interagency, and inter-location efforts; e.g.: sharing or receiving groundwater monitoring expertise, pesticide leaching and persistence expertise, water-quality expertise, and knowledge of grower relationships. The project's interdisciplinary, interagency, and inter-location water-quality team could supply the inputs needed to address a rapidly urbanizing area of the state with GIS capabilities, soil mapping and surveying expertise, skills in economics, funding experience, etc.

In many respects, the University of Florida's joint appointments for individual-faculty (between or across extension, research and/or teaching) simplified achieving collaboration; the same individuals were involved throughout the range of project activities. Which "hat" was worn depended upon whether a given activity was perceived as extension, research, or teaching.

Need for Theoretical Model

However, achieving functional integration across research, extension, and teaching entails *more than* engaging staff with individual or joint appointments in collaboration and launching multi-functional teams. Personalities come into play, along with dominant responsibilities, in determining the course of a collaborative project.

For example, generally speaking, individuals with an 80 percent research appointment and a 20 percent extension appointment *tend to view matters from primarily a research viewpoint*. A project staff member with an appointment that is predominantly research may completely cancel out ideas regarding potential extension contributions offered by a second individual who holds predominantly an extension appointment--if the latter person is more reserved, and the former more outspoken.

Hence, it is necessary to *formalize planning* of collaborative projects (around guidelines such as provided by the macro-stage model and the micro-step model). Use of one or more collaborative models would have helped to identify needs for *each* of the functions of the project --i.e., would have *forced* project staff members to *dialog in order to plan* the respective roles intended to achieve *all* the project's intended functions, rather than simply a portion of them. Such a dialog would have had strong benefits through allowing for the application of integrative models to the Lake Manatee Project.

Use of the macro-stage model and the hierarchal model would have *required joint considerations* across extension and research (and, to a lesser extent teaching, technical assistance, and financial assistance functions) throughout the course of the project. *Use of the macro-stage model and the hierarchal model would have furthered integrative planning for and evaluation of the Lake Manatee Water Quality Demonstration Project.*

Hierarchal Model and the Project's Performance

Following is an analysis of the Lake Manatee Project and its effectiveness in terms of levels of the hierarchal model.

Resources:

Over most of its six and one-half year life, the Lake Manatee Project: employed two project-specific employees; engaged several graduate students and occasional postdoctoral associates; and drew substantial time-contributions from NRCS/USDA field personnel as well as faculty members based at the University of Florida.

Involvement of project faculty members from the University of Florida included the following:

- two soil scientists, an agricultural engineer and groundwater hydrologist, and economists, from the Gainesville campus;

- a soil scientist, an agricultural engineer, and an economist from the Gulf Coast Research and Education Center, Bradenton, FL, located near Lake Manatee; and

- the local vegetable specialist and the multi-county citrus specialist from the Manatee County Cooperative Extension Service.

Most of the project's university faculty members held *joint* extension, research and teaching appointments. Over the life of the project, university staff typically consisted annually of 4.6 full-time-equivalents (FTEs) from extension staff, 3.5 FTE's from research staff, and 0.9 FTE's from resident teaching staff.

Processes:

Project activities performing primarily a *research* function were as follows:

- field-testing procedures for monitoring the quality of shallow groundwater;

- field-testing a sub irrigation system (the fully-enclosed seepage system);

- development of a Geographic Information Systems (GIS)-based interactive computer module allowing estimates of pesticide leaching and persistence, on a site-by-site basis; and

- development of a computer-based crop-growth model for commercial tomato production.

Activities performing primarily an *extension* function were as follows:

- promotion of crop- and county-specific "growers' guides" designed to include *environmental* impacts as a major criterion (in addition to pest-control efficacy) during crop-specific pesticide selection for the major soil series of the state;

- promotion of *reduced* fertilization rates and increased numbers of fertilization events throughout the crop growing season (so that less fertilizer is vulnerable to leaching by rainfall at any given point in time); and

- advocacy for use of multi-cropping systems and cover crops, to more fully consume residual fertilizer from any given cropping season, thereby *minimizing leaching* of *N* during subsequent non-cropping periods.

Activities that performed primarily *technical assistance functions* or *financial assistance functions* were as follows:

- Natural Resource Conservation Service (NRCS) staffs were involved in surveying the water quality sampling sites, interacting with participating growers, arranging for field-day tours, assisting with weekly or biweekly groundwater sampling activities, and providing an all-terrain vehicle for sampling-site access.

- Farm Service Agency (FSA) staffs disbursed, to the requesting producers, cost-share funds for management-practice improvements. This, however, was a minor factor in influencing management-practice change, for most of the vegetable and citrus growers targeted by the project perceived a large loss of individual freedom and privacy in return for a small amount of cost-share dollars.

Involvements:

Early in the project, staff mistakenly decided to *concentrate* extension efforts almost exclusively on a relatively small number of vegetable and citrus growers. These were growers with holdings physically located in the Lake Manatee watershed. Had adequate evaluation been included in the initial project plan, staff would have realized that the selected audience was too small (especially when depleted by a low return-rate of mail survey questionnaires) to constitute a statistically valid sample.

Project efforts should, instead, have been targeted to all vegetable and citrus growers in the three-county Central Gulf Coast region, (climate, soils, and management practices are relatively uniform). The decision to target primarily a small group of growers and regulatory-agency personnel during the major years of the project unnecessarily restricted its state-wide and regional extension impacts.

Interests:

It was essential for the project to seek to recruit participants who would be attracted to the project, i.e., numerous *forward-looking* grower-participants from within the project area. The prospects of recruiting increased numbers of such growers to help test-demonstrate, as well as adopt, preferred management practices would have been considerably increased had the project encompassed *all* vegetable and citrus growers in the Central Gulf Coast region, rather than only growers in the Lake Manatee watershed.

Capacities:

During project planning and implementation, existing KASAs of growers in the project area could have been identified. This would have helped project staff to see more clearly what KASA change was needed in order to achieve the requisite set of practice changes to achieve the desired social, economic, and environmental conditions. None of the project team actually thought in such terms at that time.

For example, in hindsight, *knowledge change*s necessary for project success included:

- o increased grower *awareness* of water-quality concerns and the effects of their respective farming operations on the quality of local groundwater and surface waters; and
- o nearby urban/suburban population *awareness* of extent of hazards from diminished quality of reservoir water, coupled with expectations for the role of responsible growers in maintaining adequate drinking water quality.

Innovations:

Project activities led to several documented practice-level impacts. Through adaptive research, the project field-tested and demonstrated techniques for dealing with water-quality problems in the project area and in areas with similar characteristics.

- o A computer-based, crop-growth model for commercial tomato production was interfaced subsequently with the University of Hawaii's Decision Support System for Agro-technology Transfer (DSSAT), a multi-crop framework allowing crop-growth projections for a wide variety of climatic, soil, and management scenarios world-wide.
- o Field-testing of the monitoring program for shallow groundwater led to the program's adoption at a number of locations state-wide, to enable assessments of water quality improvements resulting from management-practice changes.
- o Field-testing of the fully-enclosed seepage irrigation system led to its adoption, by NRCS, into a suite of management-practice choices for the southeastern U.S., as an intermediate step in grower conversion from the traditional, water-intensive sub irrigation (seepage) systems for vegetable production to more efficient micro-irrigation (drip irrigation) systems.

The project promoted increased numbers of fertilization events per field, over the course of a growing season. This was found to be associated with a statistically-significant, 20 percent *increase in producers' use* of split nutrient application over the 1992-1993 growing seasons (Nowak et al. 1997, 20).

Conditions:

An important feature of the Lake Manatee project was its *measurements of loadings* of agricultural chemicals to groundwater and surface waters in the project area. Such measurements were a part of the project's needs assessment as well as a part of its testing of practices and technologies to recommend for clientele use.

Establishing lagged correlations between the applications of crop fertilizers and changes in environmental conditions (i.e., groundwater and surface water contaminant loadings) was *essential* to the identification of sources of water pollutants in the project area. Making such lagged correlations was vital, as well, to local validation of the efficacy of recommended agricultural technologies and practices in correcting local water quality problems.

Funding of the project to include the above applied research was essential. Effectiveness of extension work by the project would have been minimized without this type of adaptive research.

Evaluation of the Project

There was no attempt to "tag" the uses of different sources of project funding (e.g., CSREES and University of Florida) or specific activities performed by each of the collaborating agencies (e.g., NRCS and FSA), and thereby document their respective inputs and outputs. Instead, funding and personnel inputs were simply co-mingled in order to meet the project's resource needs--as such co-mingling was essential for different kids of project outputs to be truly linked together.

As a colleague frequently comments, "If you engage in 'long-term' planning, be sure to do it often." For collaborative projects especially, *pre-planning of the evaluation* prior to project implementation is *essential for making mid-course corrections* as well as rigorously identifying project impacts.

Feedback from clientele is critical to success of projects such as the Lake Manatee Project. Such evaluation would have permitted mid-course corrections to be incorporated into project implementation, on an on-going basis. This approach obviously is superior to simply employing an initial planning effort followed by a "damn the torpedoes, full speed ahead" approach to implementing project activities.

Inclusion of formal evaluation expertise as part of the Lake Manatee Project team would have helped immeasurably in this regard. Moreover, had evaluation staff been included as team members, the project team would have viewed as integral their participation in USDA's interagency evaluation of the Water Quality Demonstration Projects; rather, Lake Manatee project staff saw the interagency external evaluation simply as "someone else's problem."

Conclusions and Implications

Since its conduct in the early- and mid-1990's, the Lake Manatee Demonstration Project has had much project-area and state-wide impact upon water-quality efforts, attitudes, and actions. The technologies and practices developed and/or tested by the project, and the subsequent, widespread adoption of these technologies and management practices has been impressive.

The project's considerable impact beyond its original area has been due in part to Florida's legislatively-mandated water quality program, enacted during the mid-1990's; (this program is funded by a tax of 50¢ per ton on the sale of all nitrogenous fertilizers). Personnel of the Lake Manatee Project were well-positioned to greatly assist the planning and implementation of this state-wide water quality program.

Normally, the *research* function and the *teaching* function on college campuses become integrated as faculties apportion their time, equipment, and support personnel to ongoing research programs and scheduled classes. The *extension* function likewise should be integrated with research and teaching functions, especially in projects of the type discussed in this paper.

Relative to other functions in collaborative projects, extension has *distinctive abilities* (e.g., identifying users' needs and perceptions, providing non-formal education, providing continuing feedback from clientele and others, and documenting behavioral changes resulting from project activities). These distinctive abilities *must be incorporated fully into collaborative research-extension projects*

In a *collaborative* project, each agency and programmatic function involved (e.g., extension, research, teaching, technical assistance, financial assistance) must be *well-represented* during project planning. Use of an *integrative conceptual model* to guide collaborative project planning, implementation, and evaluation-reporting can help *ensure adequate representation of* each agency as well as ensure that all project roles and functions are fully addressed and implemented in an integrative fashion.

In retrospect, had the Lake Manatee Project been able to employ the multi-stage model and the hierarchal model, their use almost certainly would have strengthened the project's overall cost-effectiveness. This set of "reflections" suggests examples of ways through which such strengthening would have occurred.

Appendix II.

Evaluating Project Impacts

Designs for project/program *impact evaluation* identify strategies to estimate the *extent* that outcomes may be attributed (at least in part) to a program or project, rather than wholly to other sources of influence. The discussion below presumes satisfaction of a minimal requirement of the Hierarchal Model (HM) for suggesting that a project has influenced a target audience. That is, accomplishment toward objectives at successively higher levels in the hierarchy requires evidence of progress in meeting objectives at lower levels in the hierarchy.

For example, obtaining evidence that extension project participants acquired project-targeted changes in knowledge, attitudes, skills, and aspirations (KASA) is a first step in attributing project influence on adoption of a related project-recommended innovation. Conversely, if there is no evidence of the expected KASA change, then it is unfounded to attribute to the project an influence on adoption of the related practice, even if such adoption has occurred.

However, a project may effectively induce intended KASA change that would promote adoption of a targeted innovation, yet fall short of inducing the intended practice adoption. External constraints may prevent learners from applying KASA changes they have acquired through project participation.

This Appendix focuses on evaluation of impacts of *extension* projects because accounting for alternate explanations of outcomes associated with them usually is more problematic than accounting for alternate explanations of outcomes associated with research projects.

<u>Tracking Design</u>

The tracking design simply takes, over a time period, *two or more measurements* of the outcome variable(s) associated with a project. Often, baseline data and follow-up data are collected in order to make time-series comparisons (Hatry, Winnie, and Fisk 1981). Time series designs which collect outcome data twice, e.g., before and after project implementation, are less convincing (other factors being equal) than those that repeat outcome data collection three or more times.

Tracking outcomes does not determine what role, if any, a project has performed in reaching a specific outcome. That is, outcome tracking does not identify any project impacts apart from influences from other sources (e.g., international or local economy).

When using a tracking design, it is important to discuss in the evaluation report any plausible *explanations for outcomes other than the project* being evaluated. Evaluations based on tracking data should acknowledge the possible influence of applicable non-project factors (Mayne 2000).

A program may have multiple-site projects, and time-series measurements may be conducted at each project site. If each time-series has similarly positive findings, then rival explanations for outcome(s) observed become less of a threat to attributing to the program a contribution to the observed outcomes. The projects would appear to have had a desired influence regardless of a set of contextual variables.

Comparison Tracking Designs

Comparison tracking design adds to a time-series design the collection of time-series data from a comparison group. This evaluation design tracks outcomes associated with a project, plus tracking of outcomes where the project is absent (or exists in a different form). Comparison with absence of a project attempts to ensure a high degree of similarity between a project's participants and nonparticipants who are included in the comparison group for the evaluation.

Information about the characteristics of project participants and of comparison group participants, collected *prior* to project implementation, can allow for the construction of project participant and non-participant groups that are similar to each other (Rossi, Freeman, and Lipsey 1998). Baseline and follow-up data may be collected on both the project participants and the comparison group participants.

Using a comparison group can help to tell what would have been the outcomes if the project had not been implemented. That is, *some* of the rival explanations of observed outcomes can be taken into account by comparison tracking. But, this evaluation design's power is limited, since matching of nonparticipants with project participants can only partial, not complete.*

Evaluation reports based on comparison tracking should address the possible influence of applicable non-project factors in assessing project contribution to tracked outcomes. Such factors may be partly accounted for through controls in statistical analyses.

Point-in-Time Comparison Designs

Outcome tracking can provide strong evidence regarding the extent to which targeted outcomes are achieved over time, if not evidence of project impacts. And, comparison tracking can provide *some* evidence of project contribution to achievement of targeted outcomes, i.e., evidence of project impacts

However, implementation of these *longitudinal designs* can be *complex and expensive*, particularly so for the comparison tracking design. Moreover, these longitudinal designs may be difficult to complete soon enough to assist in decisions about future programming.

An alternative is "point-in-time comparisons" in which *outcome data are collected only once*, i.e., following a period of project participation or at the conclusion of the project. While point-in-time evaluations do not track over a time-period the achievement of specific targets, logistically they are comparatively simple; they also are comparative inexpensive and require minimal time to implement.

When baseline data are absent, a point-in-time evaluation design may help to evaluate *outcomes associated* with a project and work toward *statistical and/or perceived estimates* of project impact. Two types of point-in-time designs are briefly discussed–i.e., "cross-sectional" and "retrospective."

Cross-sectional. A cross-sectional design may obtain survey data from a sample of individuals or groups in a demographically or geographically defined population (e.g., all farmers, or all farm associations, in a state).

* Lack of similarity between a project group and its comparison group can be accommodated by using an evaluation design known as the *field experiment.* This design requires making project participation available to randomly selected participants. For example, volunteers for project participation may be randomly assigned to (a) participate in the project, or (b) serve in a control group which is not exposed to the project. The field experiment is the most powerful design for determining whether observed outcomes were influenced by a project; it also is the most difficult and costly design to employ effectively (Bennett and Leonard, 1970).

Such a population normally will include both project participants and non-participants. Or, a cross-sectional design survey may be confined to only project participants, making sure to include those with different *degrees* of involvement for comparative purposes (Rivera, Bennett, and Walker 1983, 35-36).

Cross-sectional designs often obtain data on respondents' *self-reported behavior or qualities* at the time of the data collection. To deal with the question of how much a project may have contributed to observed outcomes, data from cross-sectional surveys are *statistically analyzed*.

Statistical analyses may help to identify project and non-project factors that influence outcomes. However, such analyses may be misleading due to the difficulty of statistically matching "treatment" and "non-treatment" groups, or statistically holding constant non-project factors while examining variation in outcome(s) *associated* with variation in project outputs. Because of these difficulties, authors of cross-sectional studies often are reluctant to infer whether or not a project influenced an observed outcome.

Retrospective. Retrospective design obtains data on program *participants' perceptions* of their involvement in project activities and/or the intermediate or end results of these activities. Such designs may also obtain perceptions or project results from key "third party" (i.e., non-project) observers. Two options for retrospective surveys exist. Project participants either:

C *recollect* their behavior or other qualities *prior to* their project participation (e.g., Rockwell and Kohn 1989) for comparison with their current, post-participation behavior or qualities; or

C estimate the *direction and amount of change* in their behaviors or other qualities due to their project participation (Bennett 1982).

C

The first option, "perceived before and after," and the second option, "perceived extent of change," both constitute ways to deal with the question of attribution, i.e., potential project influences on observed outcomes.*

Such survey data may include project participants and/or observers' perceptions of: (a) the extent to which outcome targets have been achieved, and satisfaction with the extent of their achievement; (b) extent to which project and/or non-project factors have produced observed outcomes; and (c) the value of different types of project information as well as non-project information for *use in decision making* (Rivera, Bennett, and Walker 1983)

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* Regarding the validity of reported *perceptions* about project impacts, House (1980) distinguishes between "subjectivist" and "objectivist" assumptions about the nature, methods, and limits of program evaluation. Objectivists maintain that evaluations should be "scientifically unbiased" through structured and reproducible techniques, consistent with logic. Objectivists argue that retrospective data are not valid evidence of outcomes, or a project's influence on outcomes, because such data are flawed by what people want to believe as well as memory loss and distortion.

Subjectivists appeal to human experience rather than "scientific objectivity." They hold that it is necessary for project evaluations to discover what participation means to project participants – i.e., to allow them to identify and assess the cumulative effects of participation. Subjectivists, moreover, maintain that perceptual findings about the influence of projects are easier for legislators, policy makers, administrators, and the public to understand and use in decision making than are findings from evaluations that employ designs based on scientific methods of objectivity.

Case Study Design

Case studies examine intensively one or a few selected individuals, groups, or communities. Case studies draw together diverse pieces of information into a unified interpretation and may provide important suggestions and insights as to project influences on observed outcomes.

Case studies generally lack the formality of the preceding evaluation designs. In contrast, case studies place less emphasis on obtaining data from representative samples. Case studies may or may not make comparisons among groups or time periods.

Case studies provide little generalizable evidence of project contributions to observed outcomes.

Their advantages include capacity to evolve systematically without relying on preconceived categories. Pre-conceived categories may or may not be inappropriate for use in an evaluation. Categories in case studies tend to *evolve* during the data collection and analysis, rather than be selected prior to data collection and analysis.

Case studies provide specific *illustrations* of conditions and trends, and therefore can be used effectively to *complement* the more structured evaluative designs that are discussed above. Also, completed case studies can be used to guide the *development* of evaluations having more designs that are more structured.

Appendix III:

Developing Requests for Proposals and and Plans of Work Guidelines

Both proposals and plans of work to conduct collaborative projects include fundamental agreements made by collaborating research and extension staffs. These agreements should cover at least the following dimensions: *project scope and priorities, roles to be performed* and *performance objectives*, and *plans for project evaluation*. Requests for proposals, and guidelines for developing plans of work, should be framed to require project staffs' consideration and consensus on these preceding dimensions, including budget considerations.

Project Scope, Priorities, and Roles

Sequential use of the macro-stage model and the hierarchal model can guide planning for the above dimensions of a collaborative project. Specifically, the multi-stage interdependence model, i.e., macro-stage model, can provide options for *defining* the following:

- *scope* of the project: i.e., which stages of the generation, diffusion, and/or utilization of knowledge, technologies, and practices, (i.e., stages of the multi-stage model) will the project address?
- *priorities* within the project: e.g., on which stage(s) defined by the new multi-stage model will the project place greatest emphasis?
- *roles* that are to be conducted *separately*: i.e., which roles identified by the multi-stage model will be performed separately by research staff and by extension staff?
- *roles* that are to be *shared*; i.e., which roles will be performed both by research staff and by extension staff?

Levels of Objectives and of Evaluative Evidence

Following are questions that a proposal for a collaborative project might seek to answer, relative to features of the hierarchal model:

- what are the project's objectives for its research function and its extension function, i.e., *objectives by level* in the hierarchy?
- if an academic function will be included in the project, what are its objectives in support of the project's research function and/or its extension function *by level* in the hierarchy?
- at which *levels* in the hierarchy will evidence be obtained regarding the project's research accomplishments and its extension accomplishments?

The questions below relate especially to selection of *linked* project objectives across the functions of research and extension, and to selection of evidence to evaluate such projects.

Conditions:

- Which *socio-cultural, economic, environmental and/or other conditions* are expected to be improved, by how much, and how soon, through (a) user adoption of (b) the research-based products or practices developed and/or tested by the project?
- How will it be known if/when the identified conditions have been *improved sufficiently* through the envisioned adoption of project-developed technologies and practices?

Innovations:

- Which high-priority knowledge, technologies and practices are to be *developed or improved, tested, and diffused*?

- What are the theoretical and/or empirical bases for selecting the high priority innovations that are to be developed, tested, and/or diffused?

- How will it be determined whether the technology/practice development (or improvement) sufficiently accomplished the project's research and development objectives?

- By *how much* is user adoption of these practices and technologies to be *accelerated* during the project period(s)?

- How will it be known to what extent and at what rate the intended audience(s) have *adopted* the recommended technologies and practices?

Capacities:

- What must be *learned* (KASAs) through research in order to develop the applicable knowledge, the practices and the technologies identified above?

- How will it be determined whether project staff have *gained*, through the research, the expected improvements in knowledge (K) and skills (S), a stronger basis for supportive attitudes (A) and aspirations (A)?

- How much change in KASAs must intended intermediary-users and/or end-users *gain* to be able to appropriately and accurately use the technologies and practices that are to be recommended for adoption?

- How will it be known if intended users are *sufficiently* gaining or have sufficiently gained these KASAs?

Interests:

- What types and range of *interests* in project activities will likely motivate cooperators to help *plan and/or conduct* the research function and the extension function of the project?

- What types and range of *interests* or *reactions* will likely motivate audiences to continue participation so that they can *be influenced* by the project's research activities and/or and extension activities?

- How will the prevalence of these interests/reactions among cooperators and audiences be determined, and how will it be known to what extent they *endorse* participation in project activities?

Participation:

- What types of public- and/or private-sector *cooperators* will be sought for research on, development of, and/or testing of new or improved knowledge, technologies and practices?

- What types and sizes of intended intermediary and end-user *cooperators* and *audiences* will be targeted for participation by the extension function of the project?

- How will it be known to what extent intended cooperators and audiences were *appropriately involved* in project processes?

Processes:

- Which *approach and methodologies* will be used to develop and/or test the knowledge (K) sought--as well as motivational bases for changes in attitudes (A), skills (S), and aspirations (A)--that are necessary for user applications?

- Which approach and methodologies will be used to *develop and/or test* the innovations that are needed to improve the conditions which are identified as problematic.

- Which approach and methodologies will be used *to convey* information that can persuade intended users to consider applying the new/improved *capacities* and *innovations*?

- How will extent, timeliness, and quality of implementation of the above research activities and extension activities be *tracked,* utilized, and reported?

Resources:

- What *types and magnitudes* of resources are needed to develop and/or test the envisioned technologies and practices; and what types and magnitude are needed to convey persuasive information about those recommended for use, and/or educate users regarding principles that are relevant to these technologies and practices?

- What types and magnitudes of resources are needed to: *evaluate need for and extent of achievement of* project objectives; utilize evaluations to improve the project and related efforts and; *report* the project's *achievements* as well as *improvements* in its operations?

- How will it be determined whether there was sufficient allocation of resources to:
(a) accomplish project objectives; (b) evaluate their extent of achievement; and
(c) judge whether project resources were effectively and efficiently expended?

<u>Collaborative Processes</u>

What are the processes by which the proposal or plan of work will be collaboratively prepared by research and extension staffs--with the input and support of stakeholders? Beyond normal costs of project planning and evaluation, what additional resources are to be available to accommodate the extra resource needs of *collaborative* planning and evaluation?

Will the collaborative processes stimulate further conceptual and theoretical developments regarding the generation, refinement, and diffusion of capacities and innovations? Will users of the macro-stage and micro-step models further develop, modify, and refine them as needed, and find ways to improve their use?